

THE UNIVERSITY
OF ILLINOIS

LIBRARY
665.06
AM
v.14

LIBRARY STORAGE



Digitized by the Internet Archive
in 2022 with funding from
University of Illinois Urbana-Champaign Alternates

.....1898.

RECEIVED FROM THE

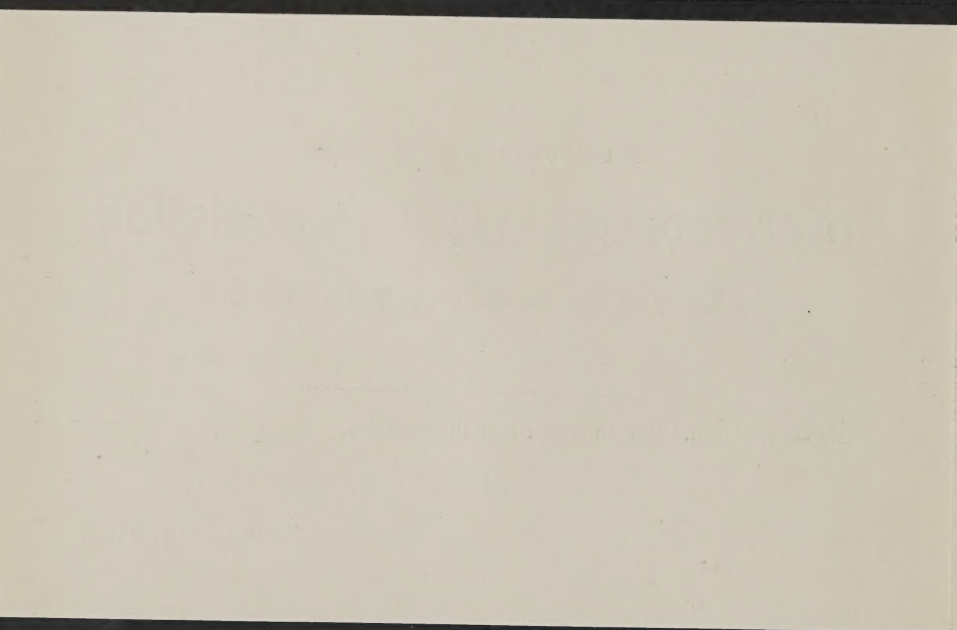
American Gas Light Association,

One Copy of the Proceedings, **Volume 14.**

.....
Please, Date, Sign and Mail Immediately to the Secretary,

ALFRED E. FORSTALL,

Montclair, N. J.



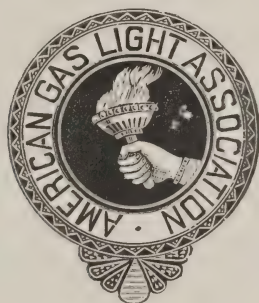
VOLUME XIV.

DECEMBER, 1897.

PROCEEDINGS

OF THE

American Gas Light Association.



TWENTY-FIFTH ANNUAL MEETING

HELD AT

OLD POINT COMFORT, VA., OCTOBER 20 AND 21, 1897.

PUBLISHED BY THE ASSOCIATION.

EDITED BY THE SECRETARY.

CHARLES F. BLOOM
PRINTER AND BINDER
137-141 WILLIAM ST.
NEW YORK

665.06

AM

v.14

REMOTE STORAGE

The Authors only are responsible for their respective articles.

CONTENTS.

	PAGE.
Twenty-fifth Annual Meeting—Roll Call.....	I
Names proposed for Membership (and elected).....	5
Report of Council.....	8
Election of Messrs. George Livesey and Corbet Woodall to Honorary Membership.....	10
Amendment to the Constitution, Adoption of.....	10
Report of Secretary.....	11
“ “ Treasurer.....	13
“ “ Committee on Education.....	14
“ “ “ “ “ Appendix.....	17
President's Address.....	53
“ “ Report of Committee on.....	131
Discussion on Mr. K. M. Mitchell's Paper on "A Method Success- fully Employed to Obviate Trouble from Naphthaline." (For the Paper, see Appendix, page lxii.).....	68
Report of Committee on Nomination of Officers.....	83
Election of Officers.....	84
Discussion on Mr. Paul Doty's Paper on "Report on Burner Stop- pages." (For the Paper, see Appendix, page xx.).....	85
Discussion on Mr. F. H. Shelton's Paper on "A Quadruplex Purifying Box; Why Not?" (For Paper, see Appendix, page i.).....	96
Question Box opened.....	107
Discussion on Mr. F. B. Wheeler's Paper on "Rust Deposits in House Pipes." (For Paper, see Appendix, page xliii.).....	110
"New Form of Purifier" (followed by discussion). A "short topic" by Mr. W. R. Beal.....	115
Report of Committee on Place of Next Meeting.....	120
“ “ “ “ Research (followed by discussion).....	120
“ “ “ “ President's Address.....	131
Discussion on Mr. Henry A. Mather's Paper on "Chemical Notes on Purification." (For the Paper, see Appendix, page xxxvii.).....	132
Discussion on Mr. R. M. Searle's Paper on "Gas Advertising." (For the Paper, see Appendix, page liv.).....	140
"Some Facts and Figures on the Testing of Consumers' Meters (fol- lowed by discussion). A "short topic" by Mr. T. Littlehales....	152
Discussion on Mr. A. S. Miller's Paper on "Some Further Experi- ments on Interior Illumination." (For the Paper, see Appendix, page xliii.).....	157
Question Box Opened.....	164

678091

Sets 2 Feb-29 Stech. = v.14

	PAGE.
"Leakage" (followed by discussion). A "short topic" by Mr. J. M. Rusby.....	168
Votes of Thanks	178
Adjournment.....	179

APPENDIX.

A Quadruplex Purifying Box; Why Not? F. H. Shelton.....	i
Some Further Experiments on Interior Illumination. Alten S. Miller.....	xiii
Report on Burner Stoppages, Paul Doty.....	xx
Chemical Notes on Purification, Henry A. Mather.....	xxxvii
Rust Deposits in House Pipes, Fred B. Wheeler.....	xliii
Gas Advertising, R. M. Searle.....	liv
A Method Successfully Employed to Obviate Trouble from Naphthaline, K. M. Mitchell.....	lxii
In Memoriam.....	lxxi
" Joseph R. Thomas.....	lxxiii
" Joseph D. Weeks.....	lxxiv
" John W. Newell.....	lxxv
" Frederick W. Norton.....	lxxvi
United States Patents Relating to Gas. Issued October 1st, 1896, to October 1st, 1897.....	lxxvii
United States Patents Relating to Gas. Expired October 1st, 1896, to October 1st, 1897.....	cvii
Current Gas Literature:	
Publications Referred to.....	cxvi
Organization.....	cxvii
Finance.....	cxix
Process.....	cxxi
Plant.....	cxxiii
Material.....	cxv
Manufacture.....	cxviii
Storage.....	cxix
Distribution.....	cxvii
Lighting.....	cxviii
Heating.....	cxvii
Power.....	cxvix
Residuals.....	cxli
Chemical.....	cxlv
Physical.....	cxlvii
Management.....	cxlix
Miscellaneous.....	cliv
New Publications.....	clxiv
List of Officers for 1897-1898.....	clxv
" " Members, Alphabetical, Honorary.....	clxvii
" " " " Active.....	clxviii
" " " " Associate.....	cxevi
" " " Geographical.....	ccii
" " " Deceased.....	ccxvii

LIST OF ILLUSTRATIONS.

BODY OF VOLUME AND APPENDIX.

Frontispiece, Chas. H. Nettleton	opp. 1
Section of Gas Holder and Tank	page 20
Differential Pressure Gauge	“ 21
Pelouze and Audouin Condenser.	“ 23
Section of Hydraulic Main	“ 28
Welsbach Burner.	“ 34
King's Pressure Gauge	“ 35
Connections for Proving Station Meter.	“ 42
Sections of Cement Joints.	“ 48
Purifier Boxes, erected 1897, for Central Union Gas Co.	115, 116
Improved Four-Way Valve used for above Boxes.	117

APPENDIX.

Side Elevation of 12x16 feet Quadruplex Purifier.	opp. iv
End “ “ “ “ “ “	“ iv
Plan “ “ “ “ “ “	“ iv
Outline Plan and Elevation 18x54 feet Quadruplex Purifier.	“ iv
Arrangement of Apparatus for “Experiments on Interior Illumination”	“ xiii
Outline Plan of Apparatus at St. Joseph, Mo., showing Pipe for Return- ing Gas from Outlet of Scrubber to Inlet of Exhauster.	“ lxvi

LIST OF SUBJECTS DISCUSSED, WITH NAMES OF SPEAKERS.

SUBJECT.	SPEAKER.	PAGE.
Election of Members	C. H. Nettleton	7
	A. C. Humphreys.....	7
	A. E. Forstall	7
Council, Report of	C. H. Nettleton	10, 11
(For Report see p. 8.)	W. H. White.....	10
	A. C. Humphreys.....	10
	G. G. Ramsdell	10
	A. C. Wood.....	11
Secretary, Report of	C. H. Nettleton.....	14
(For Report, see p. 11)	A. C. Humphreys.....	14
Treasurer and Finance Committee, Re- ports of	C. H. Nettleton	14
(For Report see pp. 12, 13.)	A. C. Humphreys.....	14
Education, Report of Committee on.....	C. H. Nettleton	52
(For Report see pp. 14 to 52.)	M. S. Greenough.....	53
President's Address	C. H. Nettleton	53
	W. H. White	67
	A. C. Humphreys.....	67, 68
Naphthaline, A Method Successfully Em- ployed to Obviate Trouble from.....	C. H. Nettleton	68, 70, 79, 82
(See Appendix, page lxii.)	G. G. Ramsdell.....	68
	W. Forstall.	69
	K. M. Mitchell..	69, 72, 73, 75, 77, 82
	T. Littlehales	69, 76
	M. S. Greenough...	69, 71, 78, 80, 81
	A. E. Forstall.....	69
	F. C. Sherman.	70, 71, 75, 76, 77, 81, 82
	R. Young	71, 75, 77, 82
	J. Somerville..	71, 72
	E. H. Jenkins	72, 73, 80
	F. Egner.....	73
	G. B. Neal	74, 75, 79
	C. J. R. Humphreys...	76, 77, 80, 81
	R. M. Searle.....	77, 80
	A. S. Miller.....	77
	H. H. White	79
	E. G. Pratt.....	79
	C. Watson.....	81
	G. T. Thompson.....	82, 83

G

SUBJECT.	SPEAKER.	PAGE.
Nominations, Report of Committee on . . .	C. H. Nettleton	83, 84, 85
	M. S. Greenough	83, 84
	A. C. Wood	84
	T. Littlehales	84
	A. C. Humphreys	85
	G. G. Ramsdell	85
	E. G. Pratt	85
	A. E. Forstall	85
Burner Stoppages, Report on	C. H. Nettleton	85, 95
(See Appendix, p. xx.)	A. S. Miller	85, 95
	S. F. Hayward	86
	A. C. Humphreys	90, 91, 94
	F. Bredel	91, 95
	F. B. Wheeler	91
	W. H. Birchmore	92
	H. A. Mather	93
	A. E. Forstall	93
	T. Littlehales	94
	Paul Doty	95
A Quadruplex Purifying Box; Why Not? . . .	C. H. Nettleton	96, 103
(See Appendix, p. i.)	T. Littlehales	97, 101, 104
	F. H. Shelton	97, 103, 104
	F. Bredel	98, 102, 107
	A. S. Miller	100, 101
	H. A. Mather	101, 102
	J. Somerville	102
	G. T. Thompson	103
	C. H. Corbett	107
	A. C. Humphreys	107
Gas House-Heating Furnaces, Bunsen		
Burner for same	C. H. Nettleton	107, 108, 110
	C. W. Blodget	108
	W. M. Crane	108, 109
	T. Littlehales	109
	A. E. Forstall	110
Communications	Secretary	83, 110
Rust Deposits in House Pipes	C. H. Nettleton	110
(See Appendix, p. xliii.)	G. G. Ramsdell	110, 111
	F. B. Wheeler	111, 112, 113
	G. B. Neal	111
	T. Littlehales	112
	C. H. Page, Jr.	112
	R. M. Searle	112
	J. Somerville	112, 113
	A. E. Forstall	113
	Paul Doty	114
	W. R. Beal	114

II

SUBJECT.	SPEAKER.
New Form of Purifiers.....	C. H. Nettleton..... 114, 119, 120
	W. R. Beal..... 115, 119, 120
	T. Littlehales..... 119, 120
	G. T. Thompson..... 119
Committee on Place of Holding Next	
Meeting, Report of.....	C. H. Nettleton..... 120
	A. S. Miller..... 120
	A. C. Humphreys..... 120
	T. Littlehales..... 120
Research Committee, Report of.....	C. H. Nettleton..... 120
	A. S. Miller..... 120, 122, 123, 124, 126, 127, 128
	A. C. Humphreys..... 122, 123, 126, 127, 128, 129, 130, 131
	T. Littlehales..... 123, 124, 128, 130
	W. R. Beal..... 123, 131
	J. Somerville..... 123, 124, 128
	Paul Doty..... 124, 129
	W. Forstall..... 124
	R. M. Searle..... 124, 125
	A. E. Forstall..... 125
	G. B. Neal..... 125, 127, 129
	C. J. R. Humphreys..... 126, 127
	F. C. Sherman..... 127
	D. R. Warmington..... 128
	E. G. Cowdery..... 129
	G. T. Thompson..... 129
	F. Egner..... 131
Committee on President's Address, Re-	
port of.....	A. C. Humphreys..... 131
	E. G. Cowdery..... 131
	Paul Doty..... 132
	G. B. Neal..... 132
	C. H. Nettleton..... 132
	J. Somerville..... 132
Chemical Notes on Purification.....	C. H. Nettleton..... 132, 135, 138
(See <i>Appendix</i> , p. xxxviii.)	A. S. Miller..... 132
	T. Littlehales..... 134
	W. H. Birchmore..... 134
	H. Pool..... 136
	G. T. Thompson..... 137
	F. B. Wheeler..... 137
	Paul Doty..... 137
	A. E. Forstall..... 138
	H. A. Mather..... 138
	A. C. Humphreys..... 139

I

SUBJECT.	SPEAKER.	PAGE.
Gas Advertising.....	C. H. Nettleton.....	140, 149, 150
(See Appendix, p. liv.)	E. G. Pratt.....	140
	W. Forstall.....	141
	G. T. Thompson.....	142
	C. J. R. Humphreys.....	143
	A. S. Miller.....	144
	C. H. Page, Jr.	144, 147
	E. A. Pinkney.....	145, 150
	Wm. McDonald (Albany).....	146
	T. Littlehales.....	146
	A. C. Humphreys.....	147, 152
	F. C. Sherman.....	148
	G. B. Neal.....	148
	E. H. Jenkins.....	148
	G. D. Roper.....	149, 150
	J. Somerville.....	150
	R. M. Searle.....	150
Testing of Consumers' Meters, Some Facts and Figures on.....	T. Littlehales.....	152, 155, 156, 157
	C. H. Nettleton.....	152
	R. M. Searle.....	155, 156
	G. T. Thompson.....	156
	E. H. Jenkins.....	156
	J. Somerville.....	157
	W. R. Beal.....	157
Interior Illumination, Some Further Ex- periments on.....	C. H. Nettleton.....	157, 160
(See Appendix, p. xiii.)	C. H. Page, Jr.	157, 162
	A. C. Humphreys.....	158
	A. E. Forstall.....	159
	A. S. Miller.....	160, 162, 163
	R. M. Searle.....	162, 163
	W. R. Beal.....	163
Encouraging the Lighting of Streets, on Which There Are No Gas Mains, with Self-Generator or Naphtha Burners...	A. S. Miller.....	164
	A. C. Humphreys.....	164
	C. H. Nettleton.....	165, 166
	D. J. Prendergast.....	165
Best Continuous Yield in Candle Power per Gallon from Gas Oil in Lowe Double Superheater Apparatus.....	A. E. Forstall.....	167
	A. B. Slater, Jr.....	167
Advantages of Having Coal Gas Benches Back-to-Back, Instead of Facing Each Other.....	C. H. Nettleton.....	167

SUBJECT.	SPEAKER.	PAGE.
Advantages of Having Coal Gas Benches		
Back to Back, Instead of Facing Each		
Other	W. A. Miller	167
(Concluded.)	F. C. Sherman.....	167
	A. E. Forstall.....	167
Liability of Trolley Companies for Dam-		
ages to Gas or Water Mains from Elec-		
trolysis	C. H. Nettleton.....	168
	G. G. Ramsdell.....	168
Leakage.....	J. M. Rusby.....	168
	C. H. Nettleton.....	173
	A. C. Humphreys..	173, 176, 177, 178
	W. R. Beal.....	174
	E. H. Jenkins.....	174, 176
	R. M. Searle	176
	C. F. Prichard.....	177
	T. Littlehales.....	177
Thanks to Retiring President.....	G. G. Ramsdell.....	178
	W. R. Beal.....	178
Thanks to Old Dominion S. S. Co.....	A. C. Humphreys.....	178
	C. H. Nettleton.....	178
Thanks to Committee of Arrangements..	Wm. McDonald	178
Thanks to Secretary.....	C. H. Nettleton.....	179

LIST OF SPEAKERS,

WITH SUBJECTS DISCUSSED.

SPEAKER.	SUBJECT.	PAGE.
BEAL, W. R.	Rust Deposits in House Pipes.....	114
	New Form of Purifiers.....	115, 119, 120
	Research Committee, Report of....	123, 131
	Testing of Consumers' Meters.....	157
	Interior Illumination.....	163
	Leakage	174
	Thanks to Retiring President	178
BIRCHMORE, W. H.	Burner Stoppages.....	92
	Chemical Notes on Purification.....	134
BLODGET, C. W.	Gas House-Heating Furnaces.....	108
BREDEL, F.	Burner Stoppages	91, 95
	Quadruplex Purifying Box.....	98, 102, 107
CORBETT, C. H.	Quadruplex Purifying Box.....	107
COWDERY, E. G.	Research Committee, Report of.....	129
	Committee on President's Address, Re- port of.....	131
CRANE, W. M.	Gas House-Heating Furnaces.....	108, 109
DOTY, PAUL	Burner Stoppages.....	95
	Rust Deposits in House Pipes.	114
	Research Committee, Report of....	124, 129
	Committee on President's Address, Re- port of.....	132
	Chemical Notes on Purification.....	137
EGNER, F.	Naphthaline, Method to Obviate Trouble from.....	73
	Research Committee, Report of.....	131
FORSTALL, A. E.	Election of Members.....	7
	Naphthaline, Method to Obviate Trouble from.....	69
	Nominations, Report of Committee on .	85
	Burner Stoppages.....	93
	Gas House-Heating Furnaces	110
	Communications.....	83, 110
	Rust Deposits in House Pipes.....	113
	Research Committee, Report of.	125
	Chemical Notes on Purification.....	138
	Interior Illumination.....	159
	Best Continuous Yield in Candle Power per Gallon of Gas Oil in Lowe Appa- ratus.....	167

I.

SPEAKER.	SUBJECT.	PAGE.
FORSTALL, A. E.	Advantages of Having Coal Gas Benches	
(Concluded.)	Back to Back	167
FORSTALL, W.	Naphthaline, Method to Obviate Trouble	
	from	69
	Research Committee, Report of	124
	Gas Advertising	141
GREENOUGH, M. S.	Education, Report of Committee on	53
	Naphthaline, Method to Obviate Trouble	
	from	69, 71, 78, 80, 81
	Nominations, Report of Committee on	83, 84
HAYWARD, S. F.	Burner Stoppages	86
HUMPHREYS, A. C.	Election of Members	7
	Council, Report of	10
	Secretary's Report	14
	Treasurer and Finance Committee, Re-	
	ports of	14
	President's Address	67, 68
	Nominations, Report on	85
	Burner Stoppages	90, 91, 94
	Quadruplex Purifying Box	107
	Committee on Place of Holding Next	
	Meeting, Report of	120
	Research Committee, Report of	122, 123,
		126, 127, 128, 129, 130, 131
	Committee on President's Address, Re-	
	port of	131
	Chemical Notes on Purification	139
	Gas Advertising	147, 152
	Interior Illumination	158
	Street Lighting beyond Line of Mains	164
	Leakage	173, 176, 177, 178
	Thanks to Old Dominion S. S. Co.	178
HUMPHREYS, C. J. R.	Naphthaline, Method to Obviate Trouble	
	from	76, 77, 80, 81
	Research Committee, Report of	126, 127
	Gas Advertising	143
JENKINS, E. H.	Naphthaline, A Method to Obviate	
	Trouble from	72, 73, 80
	Gas Advertising	148
	Testing of Consumers' Meters	156
	Leakage	174, 176
LITTLEHALES, T.	Naphthaline, A Method to Obviate	
	Trouble from	69, 76
	Report of Committee on Nominations	84
	Burner Stoppages	94
	Quadruplex Purifying Box	97, 101, 104
	Gas House-Heating Furnaces	109

M

SPEAKER.	SUBJECT.	PAGE.
LITTLEHALES, T.	Rust Deposits in House Pipes.....	112
(Concluded.)	New Form of Purifiers.....	119, 120
	Committee on Place of Holding Next Meeting, Report of.....	120
	Research Committee, Report of....	123, 124, 128, 130
	Chemical Notes on Purification.....	134
	Gas Advertising.....	146
	Testing of Consumers' Meters.....	152, 155, 156, 157
	Leakage.....	177
MATHER, H. A.	Burner Stoppages.....	93
	Quadruplex Purifying Box.....	101, 102
	Chemical Notes on Purification.....	138
MCDONALD, WM.	Gas Advertising.....	146
	Thanks to Committee of Arrangements..	178
MILLER, A. S.	Naphthaline, Method to Obviate Trouble from.....	77
	Burner Stoppages.....	85, 95
	Quadruplex Purifying Box.....	100, 101
	Committee on Place of Holding Next Meeting, Report of.....	120
	Research Committee, Report of....	120, 122, 123, 124, 126, 127, 128
	Chemical Notes on Purification.....	132
	Gas Advertising.....	144
	Interior Illumination.....	160, 162, 163
	Street Lighting beyond Line of Mains..	164
MILLER, W. A.	Advantages of Having Coal Gas Benches Back to Back.....	167
MITCHELL, K. M.	Naphthaline, A Method to Obviate Trouble from.....	69, 72, 73, 75, 77, 82
NEAL, G. B.	Naphthaline, A Method to Obviate Trouble from.....	74, 75, 79
	Rust Deposits in House Pipes.....	111
	Research Committee, Report of.....	125, 127, 129
	Committee on President's Address, Re- port of.....	132
	Gas Advertising.....	148
NETTLETON, C. H., President....	Election of Members.....	7
	Council, Report of.....	10, 11
	Secretary, Treasurer and Finance Com- mittee, Reports of.....	14
	Education, Report of Committee on....	52
	President's Address.....	53
	Naphthaline, A Method to Obviate Trouble from.....	68, 70, 79, 82

N

SPEAKER.	SUBJECT.	PAGE.
NETTLETON, C. H., President....	Nominations, Report on.....	83, 84, 85
(Concluded.)	Burner Stoppages.....	85, 95
	Quadruplex Purifying Box.....	96, 103
	Gas House-Heating Furnaces.....	107, 108, 110
	Rust Deposits in House Pipes.....	110
	New Form of Purifiers.....	114, 119, 120
	Committee on Place of Holding Next Meeting, Report of.....	120
	Research Committee, Report of.....	120
	Committee on President's Address, Re- port of.....	132
	Chemical Notes on Purification.....	132, 135, 138
	Gas Advertising.....	140, 149, 150
	Testing of Consumers' Meters.....	152
	Interior Illumination.....	157, 160
	Street Lighting beyond Line of Gas Mains.....	165, 166
	Advantages of Having Coal Gas Benches Back to Back.....	167
	Liability for Damages Caused by Elec- trolysis.....	168
	Leakage.....	173
	Thanks to Old Dominion S. S. Co.....	178
	Thanks to Secretary.....	179
PAGE, C. H., Jr.....	Rust Deposits in House Pipes.....	112
	Gas Advertising.....	144, 147
	Interior Illumination.....	157, 162
PINKNEY, E. A.....	Gas Advertising.....	145, 150
POOL, H.....	Chemical Notes on Purification.....	136
PRATT, E. G.....	Naphthaline, A Method to Obviate Trouble from.....	79
	Nominations, Report on.....	85
	Gas Advertising.....	140
PRENDERGAST, D. J.....	Street Lighting beyond Line of Gas Mains.....	165
PRICHARD, C. F.....	Leakage.....	177
RAMSDELL, G. G.....	Council, Report of.....	10
	Naphthaline, A Method to Obviate Trouble from.....	68
	Nominations, Report on.....	85
	Rust Deposits in House Pipes.....	110, 111
	Liability for Damages from Electrolysis.....	168
	Thanks to Retiring President.....	178
ROPER, G. D.....	Gas Advertising.....	149, 150
RUSBY, J. M.....	Leakage.....	168
SEARLE, R. M.....	Naphthaline, A Method to Obviate Trouble from.....	77, 80

SPEAKER.	SUBJECT.	PAGE.
SEARLE, R. M.	Rust Deposits in House Pipes.	112
(Concluded.)	Research Committee, Report of.	124, 125
	Gas Advertising.	150
	Testing of Consumers' Meters.	155, 156
	Some Further Experiments on Interior Illumination.	162, 163
	Leakage.	176
SHELTON, F. H.	Quadruplex Purifying Box.	97, 103, 104
SHERMAN, F. C.	Naphthaline, A Method to Obviate Trouble from.	70, 71, 75, 76, 77, 81, 82
	Research Committee, Report of.	127
	Gas Advertising.	148
	Advantages of Having Coal Gas Benches Back to Back.	167
SLATER, A. B., Jr.	Yield in Candle Power per Gallon of Gas Oil in Lowe Apparatus.	167
SOMERVILLE, JAMES.	Naphthaline, A Method to Obviate Trouble from.	71, 72
	Quadruplex Purifying Box.	102
	Rust Deposits in House Pipes.	112, 113
	Research Committee, Report of.	123, 124, 128
	Committee on President's Address, Re- port of.	132
	Gas Advertising.	150
	Testing of Consumers' Meters.	157
THOMPSON, G. TREADWAY.	Naphthaline, A Method to Obviate Trouble from.	82, 83
	Quadruplex Purifying Box.	103
	New Form of Purifiers.	119
	Research Committee, Report of.	129
	Chemical Notes on Purification.	137
	Gas Advertising.	142
	Testing of Consumers' Meters.	156
WARMINGTON, D. R.	Research Committee, Report of.	128
WATSON, CHAS.	Naphthaline, A Method to Obviate Trouble from.	81
WHEELER, F. B.	Burner Stoppages.	91
	Rust Deposits in House Pipes.	111, 112, 113
	Chemical Notes on Purification.	137
WHITE, H. H.	Naphthaline, A Method to Obviate Trouble from.	79
WHITE, W. H.	Council, Report of.	10
	President's Address.	67
WOOD, A. C.	Council, Report of.	11
	Nominations, Report on.	84
YOUNG, R.	Naphthaline, A Method to Obviate Trouble from.	71, 75, 77, 82



Charles H. Bellamy

THE PROCEEDINGS
OF THE
American Gas Light Association.

TWENTY-FIFTH ANNUAL MEETING,
HELD AT THE
HOTEL CHAMBERLIN, OLD POINT COMFORT, VA.,
OCTOBER 20TH AND 21ST, 1897.

FIRST DAY—MORNING SESSION.

The Association was called to order at 10 o'clock, A. M., by the President, Mr. Charles H. Nettleton.

The following members were in attendance :

Honorary Members.

Barker, F. E.,	-	-	-	-	Boston, Mass.
Foote, Allen R.,	-	-	-	-	Tacoma Park, D. C.

Active Members.

Africa, Walter G.,	-	-	-	-	Manchester, N. H.
Barret, A. H.,	-	-	-	-	Louisville, Ky.
Barrett, W. E.,	-	-	-	-	Ardmore, Pa.
Baxter, Isaac C.,	-	-	-	-	Detroit, Mich.
Baxter, William H.,	-	-	-	-	Petersburg, Va.
Beadle, A. B.,	-	-	-	-	Philadelphia, Pa.
Beal, Thaddeus R.,	-	-	-	-	New York, N. Y.
Beal, William R.,	-	-	-	-	New York, N. Y.
Betts, Edward,	-	-	-	-	Wilmington, Del.
Blodget, Charles W.,	-	-	-	-	Brooklyn, N. Y.
Borgner, Cyrus,	-	-	-	-	Philadelphia, Pa.
Bowen, W. S.,	-	-	-	-	Newport News, Va.
Bredel, Frederick,	-	-	-	-	Milwaukee, Wis.

Brown, Ernest C.,	-	-	-	New York, N. Y.
Buckman, James,	-	-	-	Philadelphia, Pa.
Burke, James E.,	-	-	-	Princeton, N. J.
Bush, John S.,	-	-	-	New York, N. Y.
Callender, E. P.,	-	-	-	New York, N. Y.
Capelle, George S.,	-	-	-	Wilmington, Del.
Cartwright, William,	-	-	-	Philadelphia, Pa.
Cathels, Edmund,	-	-	-	Hamilton, Ont.
Chollar, Byron E.,	-	-	-	St. Louis, Mo.
Collins, John,	-	-	-	Port Jervis, N. Y.
Corbett, Charles H.,	-	-	-	Brooklyn, N. Y.
Cowdery, Ed. G.,	-	-	-	Milwaukee, Wis.
Cressler, A. D.,	-	-	-	Fort Wayne, Ind.
Curley, Thomas,	-	-	-	Wilmington, Del.
Daly, David R.,	-	-	-	Jersey City, N. J.
Daniels, John M.,	-	-	-	Columbia, S. C.
Dell, John,	-	-	-	St. Louis, Mo.
Diall, M. N.,	-	-	-	Terre Haute, Ind.
Dickey, Chas. H.,	-	-	-	Baltimore, Md.
Dickey, Robert R.,	-	-	-	Dayton, Ohio.
Doty, Paul,	-	-	-	Long Branch, N. J.
Egner, Frederick,	-	-	-	Norfolk, Va.
Eilbeck, A. B.,	-	-	-	Philadelphia, Pa.
Faben, Chas. R., Jr.,	-	-	-	Toledo, Ohio.
Ferrier, James,	-	-	-	Columbus, Ga.
Flemming, Dudley D.,	-	-	-	Jersey City, N. J.
Floyd, Fred W.,	-	-	-	New York City.
Forstall, A. E.,	-	-	-	Montclair, N. J.
Forstall, Walton,	-	-	-	Lockport, N. Y.
Fowler, John,	-	-	-	Philadelphia, Pa.
Fry, C. C.,	-	-	-	Lynn, Mass.
Gandey, A. C.,	-	-	-	Lambertville, N. J.
Gates, Frederick W.,	-	-	-	Hamilton, Ont.
Greenough, M. S.,	-	-	-	Cleveland, Ohio.
Gribbel, John,	-	-	-	Philadelphia, Pa.
Hambleton, Francis H.,	-	-	-	Baltimore, Md.
Harbison, John P.,	-	-	-	Hartford, Conn.
Harper, George H.,	-	-	-	Altoona, Pa.
Harris, J. A.,	-	-	-	Philadelphia, Pa.
Herron, J. T.,	-	-	-	Buffalo, N. Y.

Humphreys, Alex. C.,	-	-	New York, N. Y.
Humphreys, C. J. R.,	-	-	Lawrence, Mass.
Jenkins, E. H.,	-	-	Covington, Ky.
Jourdan, James H.,	-	-	Brooklyn, N. Y.
Kellogg, L. L.,	-	-	Sioux City, Iowa.
Keppelman, John H.,	-	-	Reading, Pa.
Knowles, W. P.,	-	-	Richmond, Va.
Leach, H. B.,	-	-	Taunton, Mass.
Learned, Charles A.,	-	-	Meriden, Conn.
Learned, E. C.,	-	-	New Britain, Conn.
Learned, W. A.,	-	-	Newton, Mass.
Littlehales, Thomas,	-	-	Syracuse, N. Y.
Littleton, A. W.,	-	-	Quincy, Ill.
Ludlam, Edwin,	-	-	Brooklyn, N. Y.
Lynn, James T.,	-	-	Detroit, Mich.
MacDonald, B. J.,	-	-	Newburgh, N. Y.
McCullough, Edmund H.,	-	-	Philadelphia, Pa.
McDonald, Wm.,	-	-	Albany, N. Y.
McElroy, John H.,	-	-	Pittsburg, Pa.
McIlhenny, James S.,	-	-	Washington, D. C.
McIlhenny, John,	-	-	Philadelphia, Pa.
McIlhenny, John D.,	-	-	Philadelphia, Pa.
Middleton, R. L.,	-	-	Washington, D. C.
Miller, Alten S.,	-	-	Long Island City, N. Y.
Miller, C. O. G.,	-	-	San Francisco, Cal.
Miller, Wm. A.,	-	-	Cincinnati, Ohio.
Milsted, Wm. N.,	-	-	New York, N. Y.
Mitchell, K. M.,	-	-	St. Joseph, Mo.
Morton, Fred N.,	-	-	Hoboken, N. J.
Moses, Frank D.,	-	-	Chicago, Ill.
Neal, Geo. B.,	-	-	Charlestown, Mass.
Nettleton, Chas. H.,	-	-	Derby, Conn.
Nute, Joseph E.,	-	-	Fall River, Mass.
Page, Carter H., Jr.,	-	-	Philadelphia, Pa.
Page, F. D.,	-	-	Fitchburg, Mass.
Payne, M. J.,	-	-	Kansas City, Mo.
Pearson, W. H., Jr.,	-	-	Toronto, Ont.
Perkins, James D.,	-	-	New York, N. Y.
Pinkney, Edward A.,	-	-	Utica, N. Y.
Pratt, Edward G.,	-	-	Des Moines, Iowa.

Prichard, Chas. F.,	-	-	-	Lynn, Mass.
Quinn, Andrew K.,	-	-	-	Newport, R. I.
Ramsdell, Geo. G.,	-	-	-	Philadelphia, Pa.
Rice, Harry L.,	-	-	-	Norfolk, Va.
Ringwood, Thomas,	-	-	-	Ilion, N. Y.
Roots, D. T.,	-	-	-	Connersville, Ind.
Rowland, Charles L.,	-	-	-	Brooklyn, N. Y.
Rowland, Wm. L.,	-	-	-	Philadelphia, Pa.
Russell, Daniel R.,	-	-	-	St. Louis, Mo.
Russell, Henry Z.,	-	-	-	Honesdale, Pa.
Searle, R. M.,	-	-	-	Atlanta, Ga.
Shelton, F. H.,	-	-	-	Philadelphia, Pa.
Sherman, F. C.,	-	-	-	New Haven, Conn.
Slater, A. B.,	-	-	-	Providence, R. I.
Smith, Wm. H.,	-	-	-	Bayonne, N. J.
Somerville, James,	-	-	-	Indianapolis, Ind.
Stacey, William,	-	-	-	Cincinnati, Ohio.
Thompson, George Treadway,	-	-	-	New York, N. Y.
Thwing, O. O.,	-	-	-	St. Louis, Mo.
Voorhis, A. M.,	-	-	-	Nyack, N. Y.
Walker, James H.,	-	-	-	Milwaukee, Wis.
Walters, Anderson H.,	-	-	-	Johnstown, Pa.
Ward, William H.,	-	-	-	Easton, Pa.
Warmington, Daniel R.,	-	-	-	Cleveland, Ohio.
Warmington, George H.,	-	-	-	Cleveland, Ohio.
Watson, Charles,	-	-	-	Camden, N. J.
Weber, Oscar B.,	-	-	-	New York, N. Y.
Wehner, Adolph F.,	-	-	-	New York, N. Y.
Wheeler, Fred B.,	-	-	-	Long Branch, N. J.
White, Henry H.,	-	-	-	Portsmouth, Va.
White, William Henry,	-	-	-	New York, N. Y.
Williams, E. H.,	-	-	-	Waterbury, Conn.
Williams, W. L.,	-	-	-	Paterson, N. J.
Wood, Austin C.,	-	-	-	Syracuse, N. Y.
Young, John,	-	-	-	Allegheny, Pa.
Young, Robert,	-	-	-	Allegheny, Pa.

Associate Members.

Collins, David J.,	-	-	-	Philadelphia, Pa.
Crane, William M.,	-	-	-	New York, N. Y.

Eaton, Alfred B.,	-	-	-	-	Chicago, Ill.
Hayward, S. F.,	-	-	-	-	New York City.
Henderson, E. H.,	-	-	-	-	Pittsburgh, Pa.
Knight, Charles S.,	-	-	-	-	Fort Wayne, Ind.
Mansur, John H.,	-	-	-	-	Royersford, Pa.
Mather, Henry A.,	-	-	-	-	Brooklyn, E. D., N. Y.
McDonald, Donald,	-	-	-	-	Albany, N. Y.
Mordue, Thomas N.	-	-	-	-	New York City.
Page, Albion L.,	-	-	-	-	New York, N. Y.
Persons, F. R.,	-	-	-	-	Toledo, Ohio.
Roper, George D.,	-	-	-	-	Rockford, Ill.
Starr, George W.,	-	-	-	-	New Haven, Conn.
Van Wie, E. G.,	-	-	-	-	Detroit, Mich.
Van Wie, Peter G.,	-	-	-	-	Hamilton, Ohio.
Wells, Fred K.,	-	-	-	-	Chicago, Ill.
Wharton, Henry,	-	-	-	-	Philadelphia, Pa.

THE PRESIDENT—I declare the 25th annual meeting of the American Gas Light Association open and ready for business.

The first order of business will be the reading of the minutes of the last meeting.

On motion of Mr. Neal the reading of the minutes was dispensed with.

THE PRESIDENT—The next business will be the reading of the report of the Council on applications for membership.

The Secretary read the following report:

OLD POINT COMFORT, VIRGINIA, October 20th, 1897.

To the American Gas Light Association.

GENTLEMEN:—Your Council has approved the following applications for membership, and submit them to you with the recommendation that they receive favorable action:

Proposed for Active Membership.

Bissell, West, Jersey City, N. J., Assistant Superintendent United Gas Improvement Co., Jersey City, N. J.

Bowes, M., Raleigh, N. C., Superintendent Raleigh Gas Co.

Burrage, Albert C., 24 West Street, Boston, Mass., President Boston, Roxbury, Dorchester, South Boston and Bay State (of Mass.) Gas Light Companies.

*Cocke, J. T. Bowdoin, Athens, Ga., President Athens Gas Light Co.

Curtis, Samuel Philip, 26 Front Street, Newark, N. J., Works Manager at Front Street Station, The Newark Gas Co.

*Glass, Sheldon J., Montgomery Building, Milwaukee, Wis., Secretary and Treasurer, Milwaukee Gas Light Co.

Holden, Thos. F., 12th and M Streets, S. E., Washington, D. C., Superintendent East Station Works, Washington Gas Light Co.

Kipp, Leonard P., Sing Sing, N. Y., Secretary Sing Sing Gas Manufacturing Co.

*Little, F. W., 223 East Market Street, Akron, Ohio, Vice-President and General Manager The Akron Gas Co.

Marani, Virgil G., 356 Superior Street, Cleveland, Ohio, Assistant Engineer Cleveland Gas Light and Coke Co.

*Max, William J., 13 William Street, Middletown, N. Y., Superintendent Middletown Gas and Electric Light Co.

*Morrell, Edward E., Oak Park, Ills., Vice-President and Engineer Cicero Gas Co.

Reichelt, A. F., 350 Alexander Avenue, New York City, Secretary and Treasurer Central Union Gas Co.

Slade, Clefford L., Port Chester, N. Y., Superintendent Westchester Gas and Electric Co., Port Chester, N. Y.

*Spangenberg, B. H., St. Augustine, Fla., Superintendent St. Augustine Gas and Electric Light Co.

Strecker, Alexander H., Newark, N. J., Engineer and Superintendent The Newark Gas Co.

Summers, George F., Hackensack, N. J., Superintendent of Gas Department, Hackensack Gas and Electric Co.

*Woods, George E., foot East 115th Street, New York City, Chief Engineer Standard Gas Light Company.

*Young, Jas. M. H., Superintendent South Side Gas Co., Pittsburg, Pa.

Associate.

Althouse, Wilson D., room 719 Reading Terminal, Philadelphia, Pa., Coal Merchant, Althouse & Kennedy.

*Birchmore, W. H., 231 Adelphi Street, Brooklyn, N. Y., Gas Chemist, office, 117 Nassau Street, New York, N. Y.

*Carpenter, H. A., Allegheny, Pa., Engineer with Riter & Conley.

Drummond, M. J., 192 Broadway, New York, N. Y., Manufacturer of Cast Iron Pipe.

*Graves, George W., 36 St. Paul Street, Rochester, N. Y., Eastern Manager National Vapor Stove and Manufacturing Co.

*Hartenfels, P., 120 Liberty Street, New York, N. Y., Manufacturer of Patent Leak Detector for Street Mains.

*Jacobs, Charles H., Detroit, Mich., Vice-President and Managing Director Buhl Stamping Co.

Pearson, Joshua Ash, 833 Drexel Building, Philadelphia, Pa., Assistant Purchasing Agent The United Gas Improvement Co.

Prendergast, Daniel J., 33 Nassau Street, New York City, General Superintendent Welsbach Street Lighting Co. of America.

Number of Applications—Active 19

“ “ “ Associate 9

Total 28

Respectfully submitted for the Council,

ALFRED E. FORSTALL,

CHARLES H. NETTLETON,

Secretary.

President.

THE PRESIDENT:—You have heard the report of the Council on applications for membership. What is your pleasure?

MR. A. C. HUMPHREYS:—I move that the Secretary be authorized to cast the ballot of the Association for the election of the gentlemen whose names we have just heard read.

THE PRESIDENT:—There being no objection the Secretary will cast the ballot, and Mr. Humphreys will act as teller.

MR. A. C. HUMPHREYS:—I report a favorable ballot on the names just read by the Secretary.

THE PRESIDENT:—The ballot has been cast and counted and I declare the gentlemen named, duly elected members of our Association. The next business is the reading of the report of the Council.

The Secretary read the following :

REPORT OF COUNCIL.

OLD POINT COMFORT, VA., Oct. 20th, 1897.

The American Gaslight Association,

GENTLEMEN :—Your Council has the honor to make its annual report as follows :

A separate report upon applications for membership recommends the election of 28 applicants.

The resignations of six active and two associate members have been received and accepted.

The following list of papers has been approved to be read at this meeting :

"Some Further Experiments on Interior Illumination," by Alten S. Miller, Long Island City, N. Y.

"Chemical Notes on Purification," by Henry A. Mather, Brooklyn, N. Y.

"Gas Advertising," by R. M. Searle, Atlanta, Ga.

"Report on Burner Stoppages," by Paul Doty, Long Branch, N. J.

"A Method Successfully Employed to Obviate Trouble from Naphthaline," by K. M. Mitchell, St. Joseph, Mo.

"Rust Deposits in House Pipes," by F. B. Wheeler, Long Branch, N. J.

"A Quadruplex Purifying Box : Why Not ?" by F. H. Shelton, Chicago, Ill.

Your Council respectfully recommends for election to honorary membership in the Association : Messrs. George Livesey and Corbett Woodall. These gentlemen are so well known in the history of the gas industry that it does not seem necessary for us to make any plea before the Association in their favor. Their names should carry their own recommendation.

Your Council find that they cannot at present suggest any amendment to the Constitution in regard to the qualifications for membership, which matter was referred back to them at the last meeting of the Association.

The Council has taken a mail vote with reference to the advisability of changing the date of the meeting from the date at present designated by the Constitution, to some date between the 10th and the 25th of September. This vote resulted as follows:

In favor of change.....	149
Against change.....	123
Neutral.....	13

In view of the small majority the Council simply report the fact without any recommendation as to this change, but, in accordance with the instruction of the Association at the last meeting, recommend for adoption the following amendment to the Constitution:

That Article VIII, Section 34, be so amended that it will read as follows:

34. The annual meeting of the Association shall be held on the third Wednesday of October of each year at 10 o'clock A. M., at such place as shall be designated by the Association at the previous meeting. In case of emergency the Council shall have the power to change the time or place of meeting, or both, as so designated, by a three-fourths vote of all its members, at the call of the President, and such vote may be taken by mail.

The Council having been offered a medal to be presented annually for the best paper to be read at the meetings of the Association, make the following recommendation:

Mr. W. R. Beal having offered to present annually a gold medal to the writer of the most valuable paper presented at each meeting, the Council accept the same with thanks, and recommend that it be known as the "Beal Medal," and be awarded by a committee of three appointed by the President from among the past Presidents.

Respectfully submitted,

ALFRED E. FORSTALL,

Secretary.

CHARLES H. NETTLETON,

President.

THE PRESIDENT—You have heard the report of your Council. What is your pleasure?

MR. WHITE—I move that the report be received and adopted, except those recommendations requiring the vote of the Association, and that these be taken up seriatim and voted upon.

Seconded, put and carried.

THE PRESIDENT—The first matter to be taken up will be the ballot for the election of Messrs. George Livesey and Corbett Woodall as honorary members.

MR. A. C. HUMPHREYS—I move that the Secretary cast the ballot of the Association for the election of those gentlemen as honorary members.

MR. RAMSDELL—I second the motion.

Carried.

The Secretary cast the ballot, Mr. Ramsdell acting as teller.

MR. RAMSDELL—I have the honor to report that the Association has unanimously elected Mr. George Livesey and Mr. Corbett Woodall honorary members of this Association.

THE PRESIDENT—You have heard the result of the ballot. It gives me a great deal of pleasure to announce to you that Mr. Livesey and Mr. Woodall are elected honorary members of our Association. They are, as you know, two of the most prominent men in our business; and each has done much to place the gas industry throughout the world on its present successful basis.

The next item of the report of the Council which will have to be taken up is the adoption of the proposed amendment to the Constitution, which you have heard read.

MR. A. C. HUMPHREYS—I move that the Secretary cast the ballot of the Association in favor of the proposed amendment.

MR. RAMSDELL—I second the motion.

THE PRESIDENT—Is there any objection to the Secretary casting the vote of the Association in favor of this amendment? If not, those favoring the resolution will please say, Aye; contrary minded, No. The Secretary will prepare the ballot and Mr. Wood will please act as teller.

MR. WOOD—I report that the amendment to the Constitution, as read by the Secretary, has been unanimously adopted.

THE PRESIDENT—You have heard the result of the ballot. The amendment is adopted and becomes part of the Constitution.

Next in order is the reading of the reports of the Secretary and Treasurer.

The Secretary read the following:

MEMBERSHIP REPORT OF SECRETARY FOR YEAR ENDING
SEPTEMBER 30, 1897.

Honorary Members.

On roll October 1st, 1896.....	6
Elected October 27th, 1896.....	1
On roll September 30th, 1897.....	7

Active Members.

On roll October 1st, 1896.....	368
Elected October 27th, 1896.....	23
Reinstated October 27th, 1896.....	1
Transferred from Associate Membership October 27th, 1897.....	2
Dropped October 27th, 1896.....	12
Resigned during the year.....	6
Died during the year.....	2
Failed to qualify.....	1

On roll September 30th, 1897.....21 from 394=373

Associate Members.

On roll October 1st, 1896.....	55
Elected October 27th, 1896.....	9
Dropped October 27th, 1896.....	2
Resigned during the year.....	2
Died during the year.....	1
Transferred to Active, October 27th, 1896.....	2

On roll September 30th, 1897.....7 from 64=57

Total membership September 30th, 1897.....437

Deceased.

Active member, Joseph R. Thomas, New York, N. Y., November 28, 1896.

Active member, John W. Newell, New Brunswick, N. J., January 5, 1897.

Associate member, Joseph D. Weeks, Pittsburg, Pa., December 26, 1896.

Also Active member, Fred W. Norton, Nashua, N. H., died October 2, 1897, and so included in above total of membership.

RESIGNED.

Active.

George D. Bill.....	Malden, Mass.
Cornelius D. Blauvelt.....	Oradell, N. J.
J. J. Gordon.....	Cincinnati, Ohio.
Charles J. Hayes.....	Palatka, Fla.
A. Willis Tarbell.....	Waltham, Mass.
Charles A. Willets, Jr.....	Flushing, N. Y.

Associate.

Burr K. Field.....	East Berlin, Conn.
James H. Windrim.....	Philadelphia, Pa.

Dropped.

For list see Volume XIII, page 8. (On that list the 1st and 2d were Associates.)

Respectfully submitted by

ALFRED E. FORSTALL,

Secretary.

MONTCLAIR, N. J., Sept. 30, 1897.

The Treasurer read the following:

REPORT OF TREASURER FOR YEAR ENDING SEPT. 30, 1897.

Receipts.

Dues for year 1893.....	\$ 5 00
“ 1894.....	5 00
“ 1895.....	35 00
“ 1896.....	155 00
“ 1897.....	1,820 00
“ 1898.....	20 00
Life membership.....	50 00
	\$2,090 00
Initiation fees, members elected Oct. 27, 1896.....	310 00
Sale of Proceedings.....	32 25
Interest on bank deposit.....	22 60
Sale of membership badge to member.....	3 70
Advertisements in Quarterly Proceedings.....	91 88
Total receipts.....	\$2,550 43
Cash balance from last year.....	478 51
Total.....	\$3,028 94

Expenditures.

Expense of 24th Annual Meeting.....	\$ 172 98
Expense of Committee on Education.....	164 50
Expense of C. J. R. Humphreys, President, in arranging for 24th Annual Meeting.....	162 50
Report of 24th Annual Meeting.....	269 60
Publishing Proceedings, Vol. XIII.....	851 50
Distribution of Proceedings.....	76 50
Expense of Council Meeting, May 18, 1897.....	55 00
Report of Council Meeting, May 18, 1897.....	25 00
Salary of Secretary and Treasurer.....	600 00
Postage stamps, stamped envelopes and registry.....	103 18
Stationery, etc., per vouchers and P. C. Book.....	25 51
Telegrams.....	8 39
Express and cartage.....	49 90
Expense, 25th Annual Meeting, Secretary's trip to Old Point Comfort, July 10, 1897.....	21 85
R. R. Agent for 25th Annual Meeting.....	11 00
Office expenses.....	28 65
Subscriptions to various publications.....	26 17
Binding of old Proceedings.....	33 99
New Typewriter.....	55 00
	\$2,741 22
Net bank balance, per check book.....	286 72
Cash in hands of Treasurer.....	1 00
Respectfully submitted by.....	\$3,028 94

ALFRED E. FORSTALL, *Treasurer.*

OLD POINT COMFORT, VA., October 19th, 1897.

To the President and Members of the American Gas Light Association :

GENTLEMEN:—The undersigned members of your Finance Committee have duly examined the books, accounts and vouchers of the Treasurer of this Association for the year ending September 30th, 1897, and have found the same to be correct.

GEO. G. RAMSDELL, *Chairman.*

WM. R. BEAL,

GEO. TREADWAY THOMPSON,

Finance Committee.

THE PRESIDENT—You have before you the reports of the Secretary, Treasurer and Finance Committee. What is your pleasure?

MR. A. C. HUMPHREYS—I move that they be received, adopted and placed on the minutes.

Seconded, put and carried.

THE PRESIDENT—The next in order is the Report of the Committee on Education. Mr. Walton Clark, the Chairman of that Committee is unavoidably absent, and the Secretary will read the report.

The Secretary read as follows :

To the American Gas Light Association :

GENTLEMEN :—Your Committee have to report as follows : During the class year, beginning December 1st, '96, there have been issued to the students of the Class three lists of questions, and answers to the first two lists. The fourth list of questions and the Committee's answers to the third list of questions are now in the hands of the printer, and will be mailed within a few days. The students' answers to the fourth list of questions are due December 1st. It is not expected, however, that they will be all in before January 1st. Experience has indicated that not more than four lists of questions per year can be issued, with the expectation of receiving answers from the Class. While many of the Class send in their answers within a few weeks of the receipt of the questions, others—and in many cases those whom it is most desirable to retain in the Class—appear to be unable, from the conditions surrounding them, to prepare the answers under two or three months.

Copies of the questions and answers, and of the circulars issued to the Class are attached hereto.

The Class at the beginning of the first year, in the autumn of '95, numbered sixty-six. Twenty-three dropped out during the year, leaving forty-three remaining in the Class at the beginning of the second year, December 1st, '96. The Class of the current year was composed, at the beginning, of the forty-three above referred to and twenty new members, making a total of sixty-three. Of these sixty-three, fourteen have dropped out during the year, leaving forty-nine at present in the Class. The Committee have applications from seven who desire membership and who will be added to the Class the 1st of December. Therefore, if those at present in the Class continue their membership, the Class, at the beginning of the new year, December 1st, '97, will number fifty-six. (See Exhibit attached.)

The cost of the work this year is \$179.30 for printing, blue prints and stamps. (See account attached.)

There is great interest in the work on the part of many members of the Class, and it is believed by the Committee that the results justify the Association in continuing to extend aid to these men. The average membership for the year has been over fifty. The cost per member has been, to the Association, something over \$3.50. The benefit to the members of the Class is certainly out of all proportion to the amount of money expended. The Committee also believe that the benefit to the American Gas Light Association has been very considerable.

The men who are working in the Class are doing it without hope of reward other than the knowledge they may acquire. The idea of giving prizes, or rewards of any kind, has been abandoned. Every man who works in the Class is working for the knowledge that he can obtain. He is not working in competition with others and the only stimulus that he has is his desire to better qualify himself for positions of trust and responsibility in the gas business.

Respectfully submitted,

THE EDUCATION COMMITTEE OF THE AMERICAN GAS LIGHT
ASSOCIATION,

WALTON CLARK, *Chairman*,

ALEX. C. HUMPHREYS,

C. J. R. HUMPHREYS,

GEO. G. RAMSDELL,

ALFRED E. FORSTALL.

Number of members of Practical Class of the American Gas Light Association :

Beginning of first year, Fall of '95.....	66
Dropped out of Class during year.....	23
Remaining in Class beginning of second year, Fall of '96.....	43
New members of Class, beginning Fall of '96.....	20
In Class beginning of second year.....	63
Dropped out of Class during year.....	14
Remaining in Class beginning of third year, Fall of '97.....	49
New members of Class, beginning Fall of '97 (to October 15th). 7	
In Class beginning of year.....	56

Statement of expenditures in connection with Practical Class of American Gas Light Association, from October, 1896, to October, 1897 :

Printing.

November 2nd, '96.....	\$20 25
November 2nd, '96.....	37 50
April 8th, '97.....	26 25
June 12th, '97.....	31 75
July 2nd, '97.....	21 00
August 12th, '97.....	9 75
	—————\$146 50

Blue Prints.

March 1st, '97.....	\$ 4 41
June 12th, '97.....	12 40
June 28th, '97.....	8 33
August 12th, '97.....	4 16
	————— 29 30

Stamps.

January 7th, '97.....	\$ 1 00
January 20th, '97.....	50
January 22nd, '97.....	1 00
June 29th, '97.....	1 00
	————— 3 50
	————— \$179 30

APPENDIX TO REPORT OF COMMITTEE ON EDUCATION.

THIRD SERIES OF QUESTIONS FOR THE EDUCATIONAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIATION.

1. Why is it important to regulate the pressure on street mains?
2. What would you do with quick lime to prepare it for the purifiers?
3. State two or more conditions making the use of pressure regulators on house piping of advantage.
4. Explain the construction and action of a single lift gas holder. Make a sketch to illustrate your explanation.
5. Name three or more impurities in coal gas, as it comes from the condenser.
6. A gas holder is 100 feet in diameter, and gives three inches pressure when full. How much more would it have to weigh to give four inches pressure?
7. Describe a "differential pressure gauge," and explain its action.
8. Describe some method of removing tar from hot gas.
9. How often, when and in what manner would you inspect house piping to insure tightness? Give your reasons.
10. What is meant by the expression "an atmospheric (Bunsen) flame"?
11. Why is it important to have a gas works located on the lowest level of the city supplied?
12. A gas main extends from a works at sea level over a hill 100 feet high, and down on the other side to the level of the works. There is no consumption or leakage from or condensation in the main. The pressure as shown on a syphon gauge at the works is one inch. The specific gravity of the gas is .500. What is the pressure as shown on the syphon gauge on the top of the hill, and on the dead end of the main at the foot of the hill? Give your calculations with your answers. (See answers to Question 5, First List, and Question 9, Second List, Vol. XIII., pp. 29 and 40).

Answers must be in Committee's hands December 1st.

CIRCULAR OF THE EDUCATION COMMITTEE TO MEMBERS OF
THE PRACTICAL CLASS.

Those members of the Class who received the questions during the 1896 session will find enclosed, in addition to the first list of questions for the 1897 session, answers to the third list of the 1896 session.

Those members who have become connected with the Class since the 1896 session will find enclosed the first list of questions for the session of 1897.

Answers must be returned by the 20th of February, 1897.

Please write your name and address at the head of the first page of answers.

Please write your answers on one side of the paper only.

In accordance with the decision of the AMERICAN GAS LIGHT ASSOCIATION, there will be no competitive prizes given. Any money that may come into the hands of the Committee for use in this work, will be used for the general benefit of the Class.

There will be but one grade of questions, although the amount of experience among the members of the Class varies—there being some members who are practically new to the gas business, and with little schooling, and others who have been in the business a good while, and are graduates of technical schools. It is hoped that any member who may find some of the questions too advanced for him will not be discouraged, but will answer such questions as he can, having in mind the other questions as referring to matters about which it is important for him that he obtain information from books, or from those with whom he is associated.

It is hoped the members of the Class will write freely to the Chairman on any matters relative to the Class work that perplex them.

Each member of the Class will please remember to write on the envelope containing any communication his name and address, together with the following words:—"Educational matter."

January, 1897.

ANSWERS TO THIRD LIST OF QUESTIONS SUBMITTED TO THE
PRACTICAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIA-
TION. THESE ANSWERS, WHERE IN QUOTATION MARKS,
ARE TAKEN FROM THE ANSWERS SENT IN BY
MEMBERS OF THE CLASS. IN OTHER CASES
THE AUTHORITY IS GIVEN.

1. "Because a heavy pressure on the mains and services increases the leakage, and, therefore, is not desirable. But in order to insure a sufficient supply to all the consumers, the gas must be delivered from the works at a higher pressure during the hours of the greatest consumption than is necessary at other times. The pressure on the mains should be so regulated as to meet the varying demand throughout the twenty-four hours, with a minimum loss from leakage, and to insure economy at the burner."

2. Schilling, in the 1858 edition, page 75, gives the following direction:—

"The degree of moisture is of the greatest importance. In many works the rule is to slake the lime in such a manner that it will neither fall into powder nor adhere to the fingers when compressed.
* * * * In this condition, however, the lime is too dry; it causes much pressure. It is hardly possible to indicate precisely the quantity of water required for a given weight of lime, but there will be little danger of error in operating as follows:—Spread the quick lime over a stone floor, and surround it with a slight dyke of slaked lime, to prevent the water from running off; then slake it with water thrown upon the mass. It is then to be well mixed and turned over, until the whole forms a thick and homogeneous mass. It must then be thrown in a heap and left undisturbed until the next day, when it must be again worked over, and the lumps broken."

Theobald Forstall later improved upon the Schilling method, and in a paper read before the American Gas Light Association, described his improvement in the following language:—

"A simple and effective means of gauging the proper degree of moisture, and securing its uniformity throughout the whole charge of lime operated upon, is to pass the slaked lime through a wire screen, with an open mesh of one square inch area, placed at an angle of 70° with the floor. This screening reduces the lumps into

granular pellets of irregular form and size, the largest of which do not exceed the bulk of a small hickory nut. The proper degree of moisture is that beyond which any excess would cause the 'dough' to adhere to the screen instead of breaking through. Slight variations of moisture, in different portions of the charge, are corrected by the thorough mingling of the whole in the screening. The pellets do not adhere to one another spontaneously—they can be shovelled into barrows and reshovelled into the purifiers, without losing their independence; but the slightest compression and working in the hand will resolve them immediately into adhesive putty."

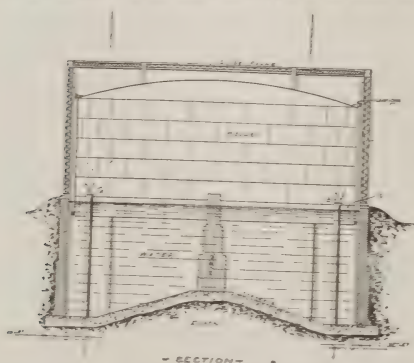
The Committee recommend to the students that they read Mr. Forstall's paper, which may be found in the Proceedings of the American Gas Light Association for 1875, in the Journal of Gas Lighting, Vol. 26, page 364, or in King's Treatise, Vol. 1, page 425.—*Com.*

3. 1st. A wide variation in the pressure at the meter.

2d. A pressure at the burner higher than consistent with the economical use of gas.

The same effect may be produced by the use of governors at the burners—*Com.*

4. "A gas holder consists of a tank, generally built of brick-work or iron, and containing water, and a cylindrical vessel made of wrought iron sheets, open at the bottom but closed on top, and



so guided in the tank and along columns rising above the tank as to work freely up and down. This guiding is performed by rollers or wheels, attached at equal distances around the top and bottom of the cylinder, working against rails or channel irons fastened to the inside wall of the tank and to the columns. The tops of

the columns are joined by girders. Gas is admitted to and drawn from the cylindrical vessel or holder proper, by pipes passing down under the foundation of tank and up to a point above the water level. When gas is admitted to the holder through the inlet pipe it

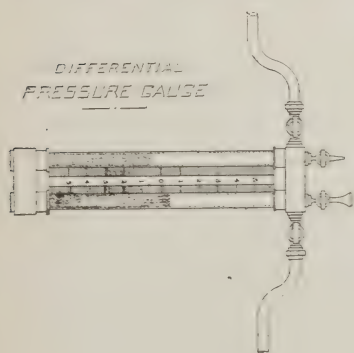
enters the space between the closed top, or roof, and the water which seals the open bottom. As the gas enters the pressure increases until it is sufficient to overcome the weight of the holder which then begins to rise and continues to do so as long as gas is entering. Gas is drawn out by opening the outlet valve, and the weight of the holder forces the gas out, and the holder falls. When gas is being sent into and drawn from the holder at the same time, the holder will rise when the volume of gas entering is greater than that leaving it, and fall when this condition is reversed." (See blue print.)

5. "Ammonia, carbonic acid and sulphur compounds."

6. It is evident that a holder throwing three inches pressure when full, must have added to it, to throw four inches pressure when full, a weight equal to a cylinder of water having the diameter of the holder and a depth of one inch. The holder in question being 100 feet in diameter, has an area of $100 \times 100 \times .7854$, or 7,854 square feet. A body of water having an area of one square foot and a depth of one inch weighs one twelfth as much as a cubic foot of water, or 5.2083 pounds, which multiplied by the area of the holder, 7854, will give the weight of water that would cover the holder one inch deep, or 40,905.99 pounds.

A cubic foot of water has been taken as weighing $62\frac{1}{2}$ pounds, in solving the above problem, although a cubic foot of distilled water, at 60° temperature, and 30 inches mercury, weighs 62.355 pounds. The commonly accepted weight is $62\frac{1}{2}$ pounds, as used in this problem—*Com.*

7. "The differential pressure gauge differs from the ordinary syphon gauge only in its mode of attachment. The latter has one



end open to the air, and serves to indicate the difference between the pressure of the gas and that of the atmosphere; while the differential gauge shows the difference in the gas pressures at two points. For instance, if one arm of the gauge is connected with the station meter inlet and the other with the outlet, the difference in the water levels will represent the difference in pressure

at these points, or the loss of pressure in passing through the meter." (See blue print.)

8. One method of removing tar from hot gas is founded upon the principle that liquefaction of the vesicles of tar held in suspension in the gas may be effected by bringing these vesicles into contact with solid surfaces, or with each other. Messrs. Pelouze and Audouin have invented a condenser, or tar extractor, designed for use with hot gas, and founded upon this principle.

The following description of the apparatus is taken from a treatise on the manufacture of coal gas, by W. Richards. The sketch is by the Committee :

"Amongst the most novel and interesting inventions for the purpose of removing the objectionable vapors of gas is the method patented by Messrs. Pelouze and Audouin—both names honorably associated with the science of gas lighting—which differs entirely from those hitherto mentioned.

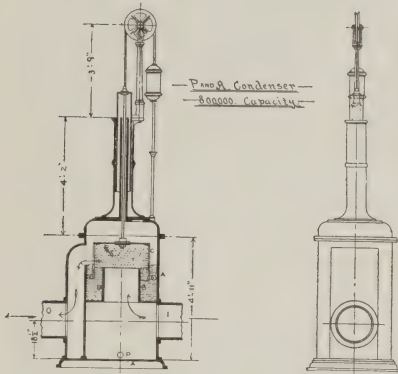
"The mode of condensing, invented by these gentlemen, is founded upon the principle that the liquefaction of the globules held in suspension by the gas is effected either by contact of the particles with solid surfaces, or with each other; and the object is to obtain, by the aid of a very simple apparatus, occupying but a small space, the complete removal of the liquid particles carried along by the gas and vapors.

The action of the apparatus is as follows : The gas to be purified is made to flow through a series of holes of small diameter, so forming jets, which strike against a surface situated directly opposite. In the passage of the gas through the holes, the liquid molecules are brought into close contact with each other, and the operation is completed by the contact with the solid surface, upon which the tarry matter is deposited.

The apparatus is represented in Fig. 31, part shown as broken away in order to explain more clearly its action. AAA is the outer case, to which are attached the inlet and outlet pipes, I and O. Concentric with the case is fixed an annular tank BB, in the middle of which is left a free passage for the gas. This annular tank is charged by preference with dead oil obtained from tar, and in it is suspended the bell or holder C, counterbalanced as represented.

The side of the bell C for a portion of its height is formed of three or more concentric cylinders which are separated by a space of about three-eighths of an inch between them. Each cylinder is

pierced, as represented at D, with a number of rows of holes each about one-twentieth of an inch in diameter, which are so placed that the gas in passing through the orifices of one of the cylinders



impinges against the plate of the next; by this means all the tarry vesicles are broken up in a manner so complete, that when the apparatus is dispensed with, a piece of writing paper being exposed to the influence of the gas issuing from a small jet is, in the course of two or three seconds, rendered almost black by the deposit of the tar;

whereas, when the condenser is in operation under like conditions the paper is not soiled in the slightest degree. The tar is deposited on the side of the bell, whence it passes off by a suitable opening to the pipe P.

A pressure gauge is placed for the purpose of appreciating when the holes in the bell become fouled, in which case simple means are provided for cleaning. The upper part of the vessel is a regulator to adjust the apparatus according to the various quantities of gas produced.”—*Com.* (See blue print.)

9. When the piping has been completed, before and after it is closed in by plastering and flooring; when alterations or additions have been made. The Sanitary Engineer and Building Record gives the following clear directions:—

“If the house is in progress of construction, see that all the outlets are carefully closed with caps, and that the foot of the rising line is stopped. Then at any convenient side light attach the ordinary gas-fitters’ pump, which is simply an air pump. To the same side light, or an adjacent one, attach the mercury column gauge used by gas-fitters with a column from fifteen to twenty inches in length. Great care must be now taken to prove that there are no leaks in the gauge or its connection or cock, and in the pump and hose connections, and a good cock should be used between the permanent gas-pipe and any temporary connections to pump, so that it may be closed immediately after the pumping

stops, to prevent back leakage of air through the pump valves or hose joints.

"When all is complete, pump the pipe system in the house full of air until the mercury rises at least twelve inches. Then close the intermediate cock before mentioned, and should the mercury column be found to 'stand' for five minutes, it is reasonable to assume that the pipes are sufficiently air and gas tight for any pressure they can afterwards be subjected to.

"Should there prove to be a very large leak, it will be apparent at once, as it will be impossible to get a pressure worth considering, the mercury simply bobbing up and down in the tube.

"It may be an outlet that has been neglected to be closed, or it may be a long split in the pipe. If the former, and very close to the pump, the mercury will not respond; but should it be far away with considerable length of pipe to cause resistance, the mercury will jump and return as suddenly. But should there be a split pipe or an aggregation of small leaks, the mercury will run back steadily, though slower than it rises, between the strokes of the pump. Should it rise well in the glass and sink at the rate of about one inch in five seconds, small leaks only in fittings or joints may then be anticipated. Of course there are exceptions to these rules, which are only for general guidance.

"To locate a leak, then, that cannot be heard blowing, strong soap water applied with a brush or sponge may be used. The liquid is rubbed over suspected joints or fittings, and air bubbles are blown by the escaping air.

"Sometimes it becomes necessary to use ether in the pipes in locating leaks, if the pipes are under floors or in partitions. The ether is put into a bend of the hose or into a cup attached to the pipe and blown into the pipes with the air. By following the lines of the pipes the approximate position of a leak may then be determined by the odor of escaping ether.

"In very large work it is well to prove a floor at a time, and when all are done, connect them with the riser and prove as a whole.

"If the house is an old one, or has been finished, and you have to test for leaks, take off the meter and cap the bottom of the riser; also unhang the gas fixtures and remove the brackets, and cap all outlets carefully. Then use ether and locate leaks before tearing up floors or breaking plaster.

"Occasionally, when a gas fitter cannot get a job tight, there is a possibility he may cut off the part or floor of the building he cannot get sufficiently tight to suit the inspector's idea of perfection. The inspector can only prove such practice by removing or slackening off a cap here or there about the house if he suspects such an attempt. If no air escapes, then he has the dead end."

Whenever a meter is set the piping should be tested by closing all outlets on the piping, and turning gas into the meter. A movement of the test hand indicates a leak.—*Com.*

10. An atmospheric or Bunsen flame is the non-luminous and blue flame produced by the combustion of gas which has been mixed with air previous to its combustion.—*Com.*

11. It may be taken as a rule that, other things being equal, the works should be situated below * * * the general level of the district supplied, as by that means advantage can be taken of the natural increase in the pressure of the gas as it travels from the lower to the more elevated parts.—*King's Treatise.*

12. "The increased pressure as shown on a syphon gauge due to an increase in elevation of 100 feet would be the weight of a column of air 100 feet high, less the weight of a similar column of gas expressed in inches of water.

$$1 \text{ cu. in. water} = .036 + \text{lbs.}$$

$$1 \text{ cu. in. air} = .00004438 + \text{lbs.}$$

A column of air 100 ft. $\times$ 1" sq. = 1200 cubic inches; and would weigh $1200 \times .00004438 = .053256$ lbs.

The column of gas of .500 sp. gr. would weigh just half as much as the column of air = .026628 lbs.

Therefore the increased pressure would be

$$\frac{\frac{1}{2} \text{ wt. of column of air}}{\text{wt. of cu. in. water}} \text{ or } \frac{0.026628}{.036} = 0.74 \text{ inches of water pressure.}$$

The pressure on the dead end of the main would be precisely the same as the original pressure at the gas works, since the loss of pressure in descending the 100 feet from the top of the hill to the sea level would be exactly the same as the increase in pressure from the gas works to the top of the hill."

In this solution air is taken as weighing .0767 lbs. per cubic foot at sea level, and the difference in density of air, due to differences in elevation, and in degree of saturation are ignored because of their slight influence.—*Com.*

FIRST SERIES OF QUESTIONS FOR THE EDUCATIONAL CLASS OF
THE AMERICAN GAS LIGHT ASSOCIATION, 1897.

1. What, if any, are the reasons for preferring lump coal to slack, or "run of the mine," for use in coal gas retorts?
2. Draw a cross section of a hydraulic main showing one dip pipe, the level of the liquid in the main, and the overflow, if it is on the side of the main. Describe the main, and its action and care.
3. What is a "struck" bushel? What is a heaped bushel? What is an American gallon? Give your answer in cubic inches and cubic feet.
4. Name in what you regard their proper order, the parts of a coal gas plant, from the hydraulic main to the purifiers, and give your reasons for so arranging them.
5. In a coal gas plant the hydraulic main is D-shaped; the seals of the tar and liquor overflows are:—hydraulic main, 16 inches; hot scrubber, 18 inches. The dip pipes are 30 inches long and dip $1\frac{1}{2}$ inches into the liquor in the hydraulic main. The internal area of each is 30 square inches. There are six to each section. The area of the liquor in the hydraulic main, outside the dip pipes, is 15 square feet. One bench is idle. All the others are at work. There is a compensator and bye-pass on the exhauster, the bye-pass not automatic. The belt on the exhauster breaks. Where will gas show first? At what pressure will it appear at the mouth pieces of the idle retorts? What would you do upon discovering the trouble, if it was your duty to remedy it?
6. Why is it important to have the water line in the drum of a station meter always at the same level? How does a change in the water line affect the registration?
7. What is meant by a "unit of heat" or, as it is sometimes called, "A British thermal unit"?
8. A station meter passed a volume of gas at a temperature of 75° and registered 1000 cubic feet; what would the same gas measure, if its temperature were reduced to the standard -60° ? Give your calculations.
9. In coal gas apparatus what is a "washer"? What is a "scrubber"?
10. What is a Welsbach gas burner?

11. What does a gas man mean when he uses the term 'back pressure'?
12. Sketch and describe a "King's" pressure gauge.

Answers must be in Committee's hands February 20th.

CIRCULAR OF THE EDUCATION COMMITTEE TO MEMBERS OF
THE PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

Enclosed herewith are answers to the first list of questions for the 1897 session, and a second list of questions.

The Committee have no special comment to make on the general character of the answers received. The Committee regret that many of the members of the class were very late in getting in their answers, making it necessary to extend the time. It is doubtful whether the time will be extended for the list now sent out. The list is not long—the questions being only thirteen in number; and the Committee feel that any member of the class can, with reasonable diligence, get the answers written so that they may be in the hands of the Committee by the 1st of June. The members of the class will kindly remember that all the answers being in before the date fixed will insure their receiving the third list at a date that will permit us to get out four lists during the year. If the delays that have occurred in connection with the first list occur in connection with the second and third lists, not more than three lists can be gotten out during the year. This will very much reduce the value of the class work to the members.

The Committee are glad to say that there continues a very general interest in the work. The majority of the members of the class are doing earnest work.

The Committee state for the benefit of the new members, that the answers in quotation marks are copied from the answers sent in by members of the class. The answers with "Com." after them are by the Committee. Any answers which are taken from other authorities are credited to the authorities which have been quoted.

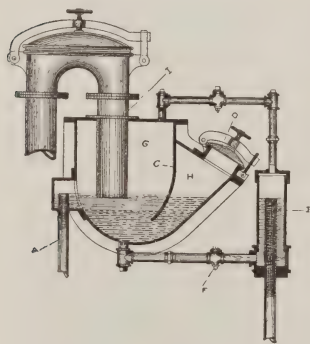
April, 1897

ANSWERS TO FIRST LIST OF QUESTIONS—1897—SUBMITTED TO
THE PRACTICAL CLASS OF THE AMERICAN GAS LIGHT ASSOCI-
ATION. THESE ANSWERS, WHERE IN QUOTATION MARKS,
ARE TAKEN FROM THE ANSWERS SENT IN BY
MEMBERS OF THE CLASS. IN OTHER
CASES THE AUTHORITY IS GIVEN.

1. Lump coal, when exposed to heat in a retort, yields its gas more readily than does slack coal or "run of the mine", "run of the mine" being a mixture of slack and lump. It loses gas less rapidly when stored. Lump coal also contains ordinarily a less percentage of ash than does slack, is more readily dried, and absorbs moisture more slowly. The net result is that lump coal stores better, and yields more gas and better coke, with a smaller consumption of fuel under the retorts, than does slack, or "run of the mine".—*Com.*

2. The accompanying blue print will illustrate the principle upon which a hydraulic main of modern construction is operated. It represents a cross section of a diaphragm main, and while not drawn to show the exact construction of any main with which the Committee is acquainted, it is drawn to illustrate as accurately as possible the principle upon which these mains operate.

Referring to the blue print, A is the liquor overflow; B the tar overflow; C the diaphragm, which extends from end to end of each section; D a cleaning door, of which there may be several on each section; G the gas space in the main; H the space through which the main is cleaned, as described below, and F and E are ordinary cocks.



The purpose of this construction is to enable the operator to draw the tar off from the bottom of the main, the liquor being drawn from above the surface of the tar; and to provide that the gas entering the main from the dip pipe I bubbles through the liquor, and does not come in contact with tar. The heavier shading shows the tar in the main; the lighter shading the liquor.

It is desirable to keep the tar so low in the main that the gas from the dip pipe will not come in contact with it. The top of the

liquor pipe A must be on the level at which it is desired to keep the surface of the liquor, and will be as much above the bottom of the dip pipe as it is desired that the dip pipe dip into the liquor. Therefore, in arranging the overflows for tar and liquor it is first important to screw up the pipe A until its upper end is at the point at which it is desired to maintain the surface of the liquor. If it is desired to carry 1" dip, the upper end of A will be 1" above the lower end of the dip pipe. The tar outlet B is then screwed down until its upper end is somewhat below the upper end of the liquor overflow A. The lower the tar overflow is set the greater will be the distance between the bottom of the dip pipe and the tar in the hydraulic main. The limit to which the tar overflow can be lowered is determined by the differences in the gravity of the liquor and the tar, and this will vary with different coals, different temperatures of retorts, and somewhat with the temperature conditions surrounding the main. It is not considered important that the tar should be more than 4" or 5" below the end of the dip pipe. This condition can be secured by setting the tar overflow from 1" to 1½" lower than the liquor overflow. As long as liquor continues to flow out of the overflow A, the tar overflow B is not too low.

It will be readily seen that the tar overflow B can be lowered to a point at which all of the liquor and tar from the main will flow through it, leaving the liquor overflow above the level of the liquor in the main, and reducing or entirely removing the seal of the dip pipe.

It may happen that there will be an accumulation of very heavy tar or pitch at the bottom of the main that will be so sluggish in its flow that the tar will cease to overflow through its provided outlet B, and all the tar and liquor will flow out through A. When this occurs, or when, for any other reason, it is desirable to clean the main, the cleaning doors D are opened, and scrapers used to draw the tar and pitch up the incline through H, and through the doors D. This can be done while the main is in operation, as the diaphragm C, dipping down into the tar in the main, prevents the gas from escaping, even when the door D is open.

When the main is in use the cocks E and F should be open.— *Com.*

3. The American "struck" bushel is the capacity of a cylindrical vessel having inside measurements of 18½" diameter and 8" high = 2150.42 cubic inches = 1.2444 cubic feet. A "heaped" bushel is such a cylinder surmounted by a cone not more than 6" high, and

having a base the diameter of the outside of the containing vessel, this vessel being $19\frac{1}{2}$ " in outside diameter. It will be seen that the diameter of the cone which forms the "heap" is 1" greater than the diameter of the interior of the vessel. This is because the "heap" is supposed to extend to the outside of the vessel used for measuring a bushel. The "heaped" bushel is, therefore, 2747.7 cubic inches = 1.5901 cubic feet. This is the capacity of a cylinder $18\frac{1}{2}$ " diameter, and 8" high, with a cone $19\frac{1}{2}$ " diameter and 6" high. The American Gas Light Association has adopted this bushel, using the "heaped" measure for coke and the "struck" for lime.

An American gallon contains 231 cubic inches, and equals in volume 8.33888 pounds of water at 39.1° F., or maximum density and 30" barometric pressure. It equals .1336 cubic feet.—*Com.*

4. 1st. Hydraulic main. 2nd. Hot scrubber and tar extractor; because it is important that the gas pass through this apparatus at the temperature at which it leaves the hydraulic main, and for the reason that the tar may be removed before it has cooled off, and, therefore, before it has gained any additional ability to absorb illuminants from the gas. 3rd. Exhauster; because it is important to have as few parts as possible of the apparatus under vacuum. As ordinarily run, all the apparatus between the hydraulic main and the exhauster contains gas at a partial vacuum, while the apparatus beyond the exhauster is under pressure. 4th. Condenser; because it is important to cool the gas before it comes in contact with the water which is to absorb the ammonia. The cooler the water and the gas the more ammonia will the water absorb per gallon. 5th. Washer and scrubber; because better purification results are obtained in the purifying boxes, and a greater yield of ammonia in marketable form—that is, in liquor—if the washer and scrubber precede the purifiers. 6th. Purifiers; because when the gas has been through the apparatus referred to above it is in condition to enter the boxes and give up its sulphur impurities and carbonic acid to the purifying material, if this is lime; or to give up its sulphur impurities only, if the purifying material is oxide of iron.—*Com.*

5. To simplify this problem we assume the pressure of the gas within the hydraulic main to be the same as that of the atmosphere. and that, therefore, the surfaces of the liquid in the main and in the dip pipes of the idle bench are at the same level. We further

assume that the liquid in the hydraulic main and in the seal pots has the same density as water.

The belt of the exhauster breaking and the generation of gas continuing, the pressure in the apparatus rises until an exit is forced and gas escapes into the atmosphere.

Gas will show first where the resistance to its escape is least and this will be through the shallowest seal between the hydraulic main and the exhauster, unless the conditions of size of hydraulic main and size and dip of the dip pipes permit it to escape through the dip and stand pipes before blowing either of the seals.

There are six dip pipes—each 30 inches internal area, or 180 inches area for the six. To fill them one inch in height will take 180 cubic inches of liquor. The area of liquor outside the dips is 15 square feet = $15 \times 144 = 2160$ square inches. The dip pipes dip $1\frac{1}{2}$ inches. Before gas can pass into the dip pipes all the liquor in the main above their lower ends must be forced up into them. That is, the liquor covering 2160 inches of surface $1\frac{1}{2}$ inches deep must be forced up six stand pipes, having a total area of 180 square inches. $2160 \times 1\frac{1}{2} = 3240$ cubic inches of liquor in the main above the lower ends of the dip pipes. $3240 \div 180 = 18$ inches, the depth to which the liquor in the main will fill the six dip pipes before gas can reach their lower openings and pass up through the liquor. But the problem states that the dip pipes dip $1\frac{1}{2}$ inches into the liquor. Therefore they contain $1\frac{1}{2}$ inches depth of liquor before that from the hydraulic main enters them. This added to the 18 inches obtained above gives $19\frac{1}{2}$ inches in depth to which the liquor would fill the dip pipes before gas could enter. Any pressure in excess of this $19\frac{1}{2}$ inches will cause gas to bubble up through the dip pipes.

The shallowest seal is at the hydraulic main overflow. It is 16 inches. Gas would show here first, as soon as the pressure exceeded 16 inches.

If this overflow were too small to carry off the gas, the pressure in the main would continue to rise until gas began to escape through the 18" seal of the hot scrubber, and if these two outlets did not sufficiently relieve the pressure, gas would, when the pressure had increased to more than $19\frac{1}{2}$ inches, escape up the dip pipes of the idle benches.

NOTE—That if the caps had been removed from the bridge pipes of the idle benches (which is good practice when letting down a

bench), the gas that would otherwise appear at the mouth-pieces would escape at the bridge pipes.

Upon discovering the trouble at the exhauster the by-pass should be at once opened, to remain open until the reserve exhauster, if there is one, has been turned on, or the belt repaired and the stopped exhauster started. All seals that have "blown" should be filled as soon as the by-pass has been opened.—*Com.*

6. It is important to have the water line in the drum of a station meter always at the same level, and the level at which it stands when the meter registers correctly, because any change of level will make a change in the number of cubic feet registered on the dial for each one thousand cubic feet passing the meter. If the water line be lowered in the drum, more gas passes for a revolution of the drum, although the amount registered on the dial will remain the same. If the water line be raised in the drum, less gas passes for each revolution of the drum. Therefore, if the water line be below the correct level the meter registers less gas than passes, and runs slow; if the water line be above the correct level the meter registers more gas than passes, and runs fast.—*Com.*

7. It is convenient to have a standard to aid us in expressing various quantities of heat, or various degrees of heating power.

The standard, or "unit of heat" used in this country, is "The British Thermal Unit," and this is the amount of heat required to raise one avoirdupois pound of pure water one Fahrenheit degree in temperature, from the temperature of maximum density of water, which is 39.1 degrees Fahrenheit. The variation in quantity of heat necessary to raise the temperature of a pound of water one degree, is so slight for any temperature between 32° and 212° that in general the heat unit may be safely taken as the amount of heat necessary to raise the temperature of one pound avoirdupois of pure water one degree Fahrenheit. Thus we may say that to raise the temperature of 30 pounds of water from 40° to 60° Fahrenheit requires 600 British Thermal Units; for we have raised 30 pounds of water through 20° of temperature, and to raise 30 pounds of water one degree requires 30 British Thermal Units, or "units of heat," or "heat units"; and to raise the same quantity through 20 degrees requires 20 times as much, or 600 heat units."—*Com.*

8. "It has been found by experiment that all perfect gases, that is, gases that contain no vapor of water or other substances, expand $\frac{1}{492}$ part of their volume at 32° F., for each increase in temperature

of one degree; that is to say, 492 volumes of gas at 32° F., would expand to $492 + 28 = 520$ at 60° F.; and 520 volumes at 60° F., would expand to 535, or one volume for each degree, at 75° F. Therefore, any volume of gas at 75° F. would bear the same relation to its volume at 60° F., as 535 bears to 520. So, if we divide 1000 cubic feet by 535 and multiply the quotient by 520, we get the volume that 1000 cubic feet of gas at 75° F. would occupy, if reduced to 60° , or 972 cubic feet."

This rule if used to determine changes in volume of illuminating gas, as ordinarily distributed, will lead to errors, because while ordinary illuminating gas if free from aqueous vapor does not differ appreciably from a perfect gas, in practice it is saturated with aqueous vapor which does not obey the laws governing the expansion and contraction of perfect gases. A table of constants has been prepared to facilitate the correction of volume of gas at different pressures and temperatures. Copies of this table with explanations of the method of preparation will be mailed to the members of the class.—*Com.*

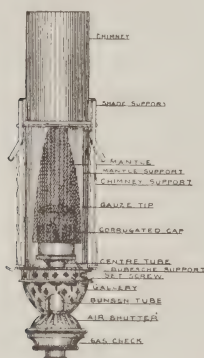
9. "In a coal gas apparatus the washer is employed to remove ammonia, ammonia compounds, and whatever of tar may be in the gas at the time it reaches the washer, while the scrubber is employed only for the removal of ammonia and ammonia compounds. The washer is a vessel so constructed that the gas passing through it is made to bubble through water. The scrubber is a vessel in which the gas comes in contact with wetted surfaces. These surfaces may be stationary, and kept wetted by a spray of water thrown over them; or they may, as in the so-called "mechanical scrubber," revolve around a central shaft, dipping in their passage into water, and rising from the water wetted, to come in contact with the passing gas."

10. The Welsbach Burner belongs to that class of lighting devices commonly known as Incandescent Gas Burners, in distinction from the Open Tip or Open Flame Burners and in which the source of light is not one of the component parts of the gas itself, heated to incandescence by another part of the gas, but is a foreign body introduced into the flame (which is perfectly non-luminous) and heated by it till it glows.

"The Welsbach Burner consists primarily of a Bunsen burner and a mantle; the gallery, air-shutter, chimney, etc., being added to give it practical value for general lighting purposes.

"The mantle is made by saturating a web of cotton thread in a fluid holding in solution salts of the rare earths. It is given the proper shape by stretching over wooden forms and is sewed at the top to the support with platinum wire. The cotton is then burned out leaving an exact reproduction of the web by the oxides of the earths.

"Referring now to the blue-print and taking up the parts in order we find first the Bunsen tube which screws on to the gas fixture.



WELSBACH BURNER

This can be divided into three parts, the base, check, and tube proper. The check is held in the base by the tube screwing down on it and is generally a flat piece of brass with three small holes in it. These holes are of different sizes for different pressures of the supply. Those for a two-inch pressure being smaller than those for a one-inch, the object being to keep the amount of gas supplied to the burner at as near three feet per hour as possible. In case of very high pressures a check with one hole is sometimes used. This check is not flat, but is slightly coned with the hole at the apex.

"The office of the air-shutter is to regulate the supply of air admitted to the tube for mixture with the gas to make the Bunsen flame. If the gas is rich, more oxygen is necessary for complete combustion than if it is poor, and the air-shutter must be opened wider in order that more air will be admitted.

"The gallery carries the mantle, shades and chimney. The mantle is mounted so that the lower part surrounds the cap and is put in place by carefully lowering the support into the lug (not shown in the print), and tightening up the set screw.

"The central tube which fits over the Bunsen tube is a part of the gallery, and holds it in the proper position. It is enlarged at the top to a mixing-chamber on which is placed the gauze held by the cap. This gauze assists in the mixture of the air and gas and also prevents the flame flashing back.

"The frame of the gallery answers two purposes, it carries the shades and protects the mantle when the chimney is being taken off or put on. The shade-supports slip over the ends of the wires

forming the frame and carry certain styles of shades; when other shades are used they can be taken off.

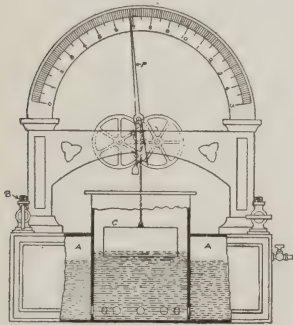
"The bobesche-supports hold the bobesche or eye-screen, a small, bowl-shaped shade which is used with the dome shade when the light is at such a height that the direct rays from the mantle are disagreeable.

"The chimney may be of glass or mica, the latter being preferable in situations exposed to draughts.

"The above is a description of the type of burner in general use. There are modifications of it for special cases but they differ only in construction and not in principle."

11. "By 'back pressure' is generally meant the total resistance offered to the passage of the gas from any point in the apparatus to its destination in the holder. For instance, the back pressure at the inlet of the purifiers, would consist of the resistance of the purifiers plus the resistance of the station meter, plus the holder pressure, plus the friction in pipes and connections. The term is also used to designate the resistance offered by any particular part of the apparatus. For instance, the difference in the pressure at the inlet and outlet of the purifiers would be spoken of as the 'back pressure thrown by the purifiers.'"

12. "The King's pressure gauge consists of a hollow box divided into two concentric compartments, of which the larger, A, into which the gas is admitted through the inlet B, is closed to the atmosphere, and the smaller, C, is open to the air at the top and is



KING'S PRESSURE GAUGE

in communication with A at the bottom. When both chambers are filled with water to a determined level and gas is admitted to A, the water in A is depressed and rises in C until the difference in levels is equal to the pressure of the gas on top of the water in A. A small metal float rises and falls with the surface of the water in C, and its motion is communicated by a cord and pulley wheel to the pointer P. This pointer moves through an arc of a circle, and indicates the pressure on a graduated semi-circular scale. The travel of the pointer for any given motion of the float depends on the size of the pulley wheel. The propor-

tions of the apparatus, and therefore the travel of the pointer over the scale for any given rise of water in the chamber C may be arranged to give the instrument almost any degree of sensitiveness; that is, to indicate small variations in pressure, smaller variations than could be easily read on the ordinary syphon gauge.

"King's pressure gauge is the invention of Mr. King, late of the Liverpool Gas Company."

SECOND SERIES OF QUESTIONS FOR THE EDUCATIONAL CLASS OF
THE AMERICAN GAS LIGHT ASSOCIATION.

1. What is hydraulic cement?
2. What distinguishes the "Portland" cement from the Rosendale and other "natural" cements?
3. Describe a hot scrubber, its use, and action.
4. What is the difference in general character between gas house coke and oven coke, and, in general terms, how is each made?
5. It is desired to "let down" a bench of six retorts, full regenerative setting. The last charge has just been put in. What is to be done in order that the bench may, with safety, be cooled down and kept idle until the increasing demand for gas, or other reason, shall make it important to again fire it up? Please consider that there are no repairs to be made to the bench.
6. Describe the testing or proving of a station meter; giving each step in the work from the putting it out of use in order to test it, to the putting it to work again, after it has been tested.
7. A certain 25-candle power water gas has a heating power of 725 heat units per cubic foot. It is desired to boil away all of ten pounds of pure water in a pot and over a burner that together will put into the water 25% of the heating power of the gas as it is burned. The water at the start has a temperature of 60°F. The barometer marks 30 inches atmospheric pressure. How much gas must be burned to entirely boil away the water? (Study answer to Question 7, First Series, 1897. Note that each pound of water turning to

steam at 212°F . absorbs 966 units of heat. In other words that when a pound of water has been raised in temperature to 212°F . it takes 966 units of heat to turn it into steam; that is, to boil it away.)

8. Give in heat units the heating power of a cubic foot of each of the following gases, and tell what you understand this expression "heating power" to mean:

Hydrogen.....H
Marsh Gas..... CH_4
Carbonic Oxide.....CO
Acetylene..... C_2H_2

9. What action takes place between "oxide of iron" and sulphuretted hydrogen in the purifiers? What change occurs in the mass when exposed to the atmosphere, after use in the boxes? Give a general answer, and then give the chemistry of the operations as far as you can.
10. Describe the making up of a cement joint in a 6-inch cast iron hub and spigot street main, giving approximately the amount of materials used, and the time the man works at the joint. Draw a section of the joint, giving dimensions.
11. What is naphtha?
" " crude oil?
" " gas oil?
12. How do you determine when the checker brick in your water gas apparatus needs cleaning?
13. Give a brief description of calcium carbide, and of acetylene, and their properties.

Answers must be in Committee's hands June 1st.

CIRCULAR OF THE EDUCATION COMMITTEE TO THE MEMBERS OF
THE PRACTICAL CLASS—AMERICAN GAS LIGHT ASSOCIATION.

Enclosed herewith are answers to the second list of questions for the 1897 session, and a third list of questions.

The Committee can congratulate the members of the class generally upon an improvement in the character of their answers. The questions have been more difficult. The answers show greater

care in their preparation, and a more intelligent understanding of the matters treated of, than did answers to previous lists.

The Committee have again to express regret that many members of the class are very late in getting in their answers.

Enclosed you will find a catalogue of books on gas and kindred subjects, issued by the Progressive Age Publishing Company, who have kindly sent us a sufficient number to enable us to enclose one to each member of the Practical Class.

Please note that all communications, answers to questions, etc., should be addressed to Walton Clark, Chairman, 813 Drexel Building, Philadelphia, and the envelope containing such papers should have written on it "Educational matter."

Also please note that answers should be plainly marked with the name of the writer—preferably on the first page.

The answers to the list of questions herewith enclosed must be in the hands of the Committee by the 15th of August.

June, 1897.

ANSWERS TO SECOND LIST OF QUESTIONS—1897—SUBMITTED
TO THE PRACTICAL CLASS OF THE AMERICAN LIGHT ASSO-
CIATION. THESE ANSWERS, WHERE IN QUOTATION
MARKS, ARE TAKEN FROM THE ANSWERS SENT IN
BY MEMBERS OF THE CLASS. IN OTHER
CASES THE AUTHORITY IS GIVEN.

1. What is hydraulic cement?

Ans. Hydraulic cement is an impure lime, that has the property of "setting" or hardening, under water. It is made by "calcining", or burning, limestone containing a large percentage (20 to 60) of clay, or a mixture of limestone and clay artificially prepared. It is sometimes called "hydraulic lime," though this term is more generally applied to calcined limestone containing a smaller proportion of clay.

Hydraulic cements are ground fine for use, and must be kept dry to preserve their value. They have the property of "setting" hard, and are used in masonry to unite in one hard, strong mass the individual bricks or stones used in foundations, walls, etc — *Com.*

2. What distinguishes the "Portland" cement from the Rosendale and other "natural" cements?

Ans. Some hydraulic cements are made from rock which contains the desired proportions of limestone and clay. These are known as "natural cements," and are sometimes called Rosendale cements, from a town in New York.

In the manufacture of some hydraulic cements the limestone and clay are mixed artificially, and in definite proportions, before burning, and the product of this process of preparation is known as "Portland cement." This cement, being a mixture of exact and predetermined proportions of the necessary materials, is a more valuable building material than most of the natural cements.

Portland cement takes its name from the resemblance artificial stone made of it bears to stone found on Portland Island, south of England. The original Portland cement was a natural cement, but the name is now used to distinguish the cements made from an artificially prepared mixture of ingredients as detailed above.

From good authority we have the statement that cement owes its hydraulic quality to certain silicates and aluminates of lime formed during the burning, by the action of the heat, and which possess the property of taking up water of hydration and crystallizing to a hard and compact mass.—*Com.*

3. Describe a hot scrubber, its use and action ?

Ans. "If the vapors of tar which are present in coal gas in the hydraulic main could be carried by the gas to the consumer's burner they would be valuable as illuminants, but this cannot be realized because they liquefy at ordinary temperatures and form tar. This liquid tar condensed from the gas, if allowed to cool in contact, or to travel with the gas, will absorb from the gas other light hydrocarbon vapors, which form, when burnt, the most useful light givers. It is, therefore, important to separate these vapors of tar from the gas as quickly as possible, and while it is still hot, so that the maximum of light hydrocarbon vapors will be retained in the gas. This is accomplished by the hot scrubber. The gas and tarry vapors leave the hydraulic main at a high temperature (between 110° and 150° Fahr.), and pass into the hot scrubber. The gas should leave the hot scrubber at as near the entering temperature as possible. The hot scrubber may act on the principle of separation by friction, in which case the scrubber will consist of a shell filled with coke or wooden grids; or it may act on the principle of straining through small orifices and striking baffle plates, one type of such apparatus

being the P. and A. condenser, described in the answer to Question 8, Third Series, 1896."

4. What is the difference in general character between gas house coke and oven coke, and, in general terms, how is each made?

Ans. "Gas house coke is made as a bye-product in the manufacture of coal gas, and is that portion of the charge remaining in the retorts after the gas has been driven off.

"There are various forms of ovens used in making oven coke, but that known as the "bee-hive" oven is by far the most generally employed. As its name implies, the interior of this oven is dome shaped, precisely like a bee hive, and is generally built from 11 to 12 feet in diameter, and from 5 to 6 feet in height. The working is very simple, depending on the principle that the heat necessary for the coking of the charge is supplied by the combustion in the oven itself of a portion of the escaping gases and more or less of the fixed carbon of the charge. The coal is dumped through an opening in the crown of the oven, and spread evenly on the floor to an average depth of about 2 feet. The front opening, through which the coke is discharged, is at first nearly closed with brick, luted with loam. The heat of the oven from the previous coking fires the charge, and as the coking progresses the air is more and more shut off by luting the openings and finally closing the roof openings. The average charge is 7600 lbs., and the time of coking is 48 hours, with 72 hours for that burned over Sunday. When the coke is thoroughly burned, the door is removed, and the coke is cooled by water thrown in from a hose, and then drawn.

"Gas house coke is comparatively soft and friable, due chiefly to the short time occupied in burning off the charge,—from 4 to 6 hours,—also to the lower temperature of carbonization, whereby the volatile constituents of the coal have not been driven off as completely as in oven coke.

"Oven coke is porous in structure, but very hard, with a metallic ring and a bright silvery-gray lustre."

Oven coke is also made in ovens designed to enable the operator to utilize the gas, tar and ammonia produced.—*Com.*

5. It is desired to let down a bench of six retorts, full regenerative setting. The last charge has just been put in. What is to be done in order that the bench may, with safety, be cooled down and kept idle until the increasing demand for gas, or other reason, shall

make it important to again fire it up? Please consider that there are no repairs to be made to the bench.

Ans. In letting down a bench of retorts with full depth regenerative setting, the last charge should be made as large as the retorts will hold. That is, if the charges are of 4 hours duration and the bench is to be let down at 7 o'clock, the charges from 3 o'clock on should be made to almost fill the retorts. The coke from these charges must not be drawn until the bench is cold. The furnace should be left half full of coke. When the last charge is put in, the primary air-slides should be shut down to within $\frac{1}{2}$ " of being closed, secondary air shut off entirely and the dampers closed until there is just sufficient opening left to maintain a slight draft in the furnace. Two or three hours after the last charge is put in, the primary air ports should be closed entirely, all cracks around the brick work plastered up, so as to prevent the entrance of any air into the setting, the opening around the furnace charging door filled with coke dust or ashes to prevent any influx of air at that point, and the dampers practically closed, leaving them just cracked, so as to take off what little gas is still being generated in the furnace, but not open enough to cause any draft through the bench. After the gas is all driven out of the coal in the retorts, the bridge pipe covers should be raised, so that in case there is any leakage of gas up the dip pipes through excess of pressure in the hydraulic main, it will escape through the open bridge pipe, instead of working down into the retorts and forming an explosive mixture which might be fired and damage the bench. After all these precautions have been taken, the bench must be allowed to cool down thoroughly, which it will do very slowly, before anything about it is opened for examination or for cleaning the furnace. If handled in this way, the cooling of the setting will be so gradual as not to cause any avoidable injury to retorts or blocks.—*Com.*

6. Describe the testing or proving of a station meter; giving each step in the work from the putting it out of use in order to test it, to the putting it to work again, after it has been tested.

Ans. The meter room should be thoroughly ventilated throughout the test.

The object of testing a station meter is to determine

A—Whether there are any leaks in the drum.

B—If there are no leaks, how many cubic feet of gas are passed for one revolution of the drum.

C—Whether the index registers correctly the number of cubic feet passed through the drum.

Before the meter is put out of use for the purpose of testing it, remove the plate over the dial, thus exposing the spindle that comes through the meter head; stop the meter long enough to attach a pointer to the spindle, and make a mark on the case, so that exact revolutions of the pointer can be counted. Then start the meter and note how much gas is registered on the index for ten or twenty revolutions of the spindle. Calculate from this the number of cubic feet registered for each revolution of the spindle. The use to be made of this figure will be explained later on.

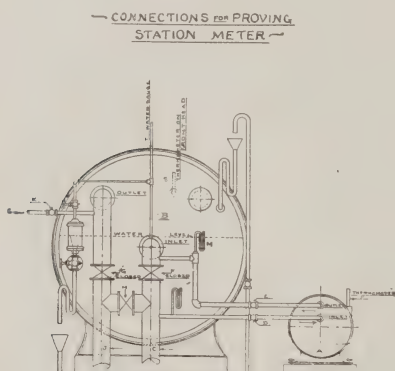
Put the meter out of use by opening the by-pass and closing valves F and G. Pour water into the connections C and J above these valves, to seal the valves. Pet-cocks should be tapped into

these pipes above the valves, and below the surface of the water, and opened from time to time during the test, to see that these valves remain sealed.

Now the meter is out of use and ready to be tested.

A—Does the drum leak?

Connect the test meter and iron pipes, as shown, and run the pipe L out of doors.



Test the connections of the test meter by opening the cocks D and E and passing a little gas through both meters. Then close the cock K. When the full pressure of the gas shows on both meters, if the index of the test meter remains stationary, the outlet connections and the station meter case and gas connections above valves F and G are gas tight.

Close cocks D and E. Remove gauge M and open cock K, and having thus put atmospheric pressure on both inside and outside of the station-meter drum, see that the water in the meter is exactly to the mark on the water gauge and dripping from the automatic overflow, if the meter has this attachment, at the rate that is maintained when the meter is in regular use. Then close K and

replace gauge ; shut off automatic overflow, and close off water supply. Remove the manhole plates on top of station meter ; remove one of the plugs in the drum and replace it with a special plug fitted with an eye-bolt, attach a rope to the eye-bolt and make the rope fast to prevent the drum turning. Open cock E, then open cock D slowly, thus admitting gas gradually into the station meter drum until the pressure has increased sufficiently to blow the seals in the meter. The noise of the blowing gas can be heard and the pressure will fluctuate violently. The blowing pressure should be recorded. Now shut D and watch gauge M ; if the pressure falls, that section of the drum that is being tested leaks. The size of the leak can be determined by partly opening D, keeping pressure on M below the pressure at which the seals blow and noting the registration of the test meter for say ten minutes. Now leave D open and slack the rope until the meter drum has made about one-eighth of a revolution, and repeat the test made above. Repeat this process until the drum has been tested for blowing pressure and for tightness in eight positions. The drum should then have made one revolution.

If the manhole is not available for this test, the spare outlet flange can be removed and the drum blocked in different positions by a piece of scantling.

Before starting to revolve the drum, the position of pointer on spindle on meter front should be accurately marked, and note should be made of the number of revolutions made by the pointer for one revolution of the drum ; this is usually exactly one or exactly two.

If the drum leaks it must be repaired before test for capacity can be made.

If the drum is tight proceed to determine.

B—How many cubic feet of gas are passed by one revolution of the drum.

Remove the rope, replace plug and manhole, open automatic overflow and water supply pipe. Repeat test for tightness of connections and case.

Open the cock K, and adjust the cock D on the test meter inlet until the gas passes at a rate within the limit of the test meter. Then wait until water begins to drip from the automatic overflow.

The gas now passing through both meters, one observer should call out at the instant the pointer on the station meter spindle

reaches the mark on the case, and a second observer should, at the same instant, note and record the test meter reading. When the drum has made one complete revolution as indicated by the pointer, note and record the test meter reading as before. The quantity, thus registered by the test meter is the quantity of gas passed by one revolution of the station meter drum. To ensure accuracy at least three revolutions of the drum should be made.

During this test the temperature of the water in the two meters should be as nearly as possible the same as the temperature of the room.

C—Does the index register correctly the number of cubic feet passed through the drum.

Count the teeth on the gear wheels connecting the spindle with the meter index and calculate the number of cubic feet registered by one revolution of the meter drum. This figure should agree closely with that obtained at the outset, by calculating from the registration of the meter during twenty revolutions. This latter figure was obtained for the purpose of checking the calculations from the gear wheels. Accept the figure obtained by counting the teeth on the gear wheels as correct.

If the figures obtained by tests B and C are the same, the meter is correct; if the quantity passed (B) is greater than the quantity registered (C), the meter is slow; if the contrary, the meter is fast. If the meter is incorrect, it is better to change the gears, leaving the water level at the position marked. If inconvenient to have gears changed, alter water line to correct, raising it if meter is slow and lowering if meter is fast and test again. Only very small errors can be corrected for by this method, and it should be used only on small meters.

To put the meter in use again, remove the test meter connections and pipe L; remove the pointer from spindle and replace dial plate, open valves F and G, and close valve H.

NOTE—Test meter is preferably a 60 or 80-light wet meter, with a dial registering to one-tenth of a cubic foot. This meter should be carefully tested on a meter prover when passing gas at the same rate as during the station meter test. This can be readily done by maintaining the same difference of pressure between inlet and outlet of test meter, as observed during test B.

The test meter should always be set level.

NOTE—Test A can be made without a test meter, using a pressure gauge only. A common, dry meter can be used to measure the leakage.

NOTE—If the temperatures of the gas passing through the test meter and through the station meter are different, the volume of the gas passing through the test meter should be corrected to the temperature of the gas passing through the station meter. This can be done by the use of a table for the correction of the volumes of gas at different temperatures.

NOTE—If the meter drum leaks have it repaired. Do not attempt to correct for leaks in drum by raising water line.

The above is an accurate and scientific, if somewhat difficult method of proving a station meter. A more simple method is as follows:

To prove the tightness of the drum—Proceed as above down to and including the determination of the tightness of case and connections, and the correctness of the water line. Then run gas through both meters at a rate about equal to the maximum capacity of the test meter; and again at half that rate, making the test cover in each case an equal number of and at least three full revolutions of the drum of the station meter. If the tests agree the drum is tight.

This method does not necessitate opening the manhole of the meter.

Determine the capacity of the drum per revolution as above.

Count the teeth on the gear wheels as above and calculate the number of feet registered by one revolution. If you do not understand the gear wheel and dial combination, test for drum tightness and capacity as above, disconnect test meter and turn gas through the station meter as if in regular use for twenty revolutions of the drum, as shown on the pointer. See if the dial registers twenty times the determined capacity of the drum. If it does, the meter registers correctly—*Com.*

7. A certain 25-candle power water gas has a heating power of 725 heat units per cubic foot. It is desired to boil away all of ten pounds of pure water in a pot and over a burner that together will put into the water 25 per cent. of the heating power of the gas as it is burned. The water at the start has a temperature of 60° F. The barometer marks 30 inches atmospheric pressure. How much gas must be burned to entirely boil away the water? (Study answer

to question 7, First Series, 1897. Note that each pound of water turning to steam at 212° F., absorbs 966 units of heat. In other words, that when a pound of water has been raised in temperature to 212° F., it takes 966 units of heat to turn it into steam, that is to boil it away.)

Ans. If the gas has a heating power of 725 heat units per cubic foot, and the burner and pot enable us to put 25 per cent. of the heat from the burning gas into the water, each cubic foot of gas will give to the water $\frac{25}{100}$ of 725 heat units, or 181.25 heat units. To raise one pound of pure water from 60° to 212 (the barometer marking 30 inches) will require $212 - 60 = 152$ heat units. To boil away one pound of water, after it has been heated to 212° , will require 966 heat units. Therefore, to raise one pound of water from 60° to 212° and boil it away, will require $152 + 966 = 1118$ heat units. Ten pounds of water will require ten times as many heat units, or 11,180 heat units. To put the 11,180 heat units into the water, we must use of our 725 heat unit gas, through our burner and pot giving 25 per cent. efficiency, $11,180 \div 181.25$ ($725 \times .25 = 181.25$ heat units per cubic foot utilized) = 61.68 cubic feet. The imperfection of the apparatus and other causes, have made it necessary to waste three times as much heat as has gone into the water, for if 25 per cent. went into the water, 75 per cent. must have gone into the air and surrounding objects. If all the steam formed from the water were condensed to water, and the water so formed reduced in temperature to 60° , the 11,180 heat units put into the water would be given up by it, and it would contain only the heat it had before the operation of heating and boiling it began.

The heat necessary to add to a body to raise its temperature a certain amount, is exactly the amount it will give up in going back to its original temperature. Thus, a pound of water must have given to it ten heat units to raise it from 60° to 70° F., and it will give up ten heat units in cooling from 70° to 60° F.—*Com.*

8. Give in heat units the heating power of a unit power of a cubic foot of each of the following gases, and tell what you understand this expression "heating power" to mean:

Hydrogen —	H —	<i>Ans.</i>	325.5	heat	units	per	cubic	foot.
Marsh gas —	CH —	"	1022.8	"	"	"	"	"
Carbonic oxide —	CO —	"	324.7	"	"	"	"	"
Acetylene —	C ₂ H ₂ —	"	1493.4	"	"	"	"	"

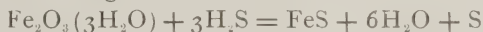
PROF. JULIUS THOMSEN.

The "heating power" of a cubic foot of gas is its power to raise the temperature of other substances by the heat developed in its complete combustion. It is ordinarily measured and expressed by the number of pounds of pure water that the heat developed by the complete combustion of the gas is capable of raising one degree F. in temperature, when all the heat developed is utilized in heating the water.—*Com.*

9. What action takes place between "oxide of iron" and sulphuretted hydrogen in the purifiers? What change occurs in the mass when exposed to the atmosphere, after use in the boxes? Give a general answer, and then give the chemistry of the operations as far as you can.

Ans. When the sulphuretted hydrogen in the gas comes in contact with the oxide of iron in the purifiers, the sulphur of the former unites with the iron and forms iron sulphide, and the hydrogen unites with the oxygen and forms water. At the same time, one-third of the sulphur of the sulphuretted hydrogen is liberated in a free state.

The chemical changes are shown in the formula:



After the mass has been fouled it is exposed to the air. The iron of the iron sulphide unites with the oxygen of the air and with the water that is present in the shape of moisture in the mass and in the atmosphere, and forms oxide of iron, while the sulphur is liberated in the free state.

The chemical changes are shown in the formula:



10. Describe the making of a cement joint in a 6 inch cast iron hub and spigot street main, giving approximately the amount of materials used, and the time the man works at the joint. Draw a section of the joint, giving dimensions.

Ans. We give two answers to question 10. It is believed by the Committee that following the rule given in either answer will result—if the materials are first class and the workmanship good—in a tight and strong joint; but the Committee prefer the joint first described.

JOINT No. 1.

Use Portland cement. Natural cements are not uniform in quality, and, as a rule, are too quick-setting to permit of their use

with safety. In selecting the brand, take a relatively quick-setting Portland. If the cement sets too slowly there is danger of the finished joint being disturbed before setting.

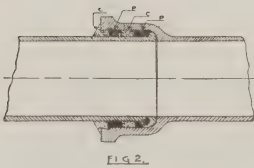
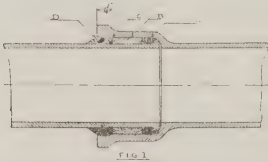
Use the cement neat—no sand.

Use the cement as dry as possible, so that it requires hammering the yarn against it in order to bring the moisture to the surface. When sufficient water is added the cement will still appear crumbly in the pan, and will just retain the impression of the fingers when squeezed in the hand.

The cement should be used immediately after mixing; if it lies unused over five minutes, it should be discarded. The cement remaining in the pan should be entirely removed before mixing up any new cement. In mixing cement, first determine the quantity required for one joint, and the quantity of water required for this cement, and then always use the cement and water *by measurement*.

Use jute yarn, untarred. When the joint is made the yarn and sides of joint may be moist or damp, but should not be wet.

The finished joint should consist of one roll of yarn (Fig. 1 A), of the exact circumference of the pipe, twisted and driven tightly to the bottom of the bell; then a solid mass of cement (Fig. 1 B), extending to a point about $1\frac{1}{2}$ " back of the face of the bell; then a second roll of yarn (Fig. 1 C); then a facing of cement (Fig. 1 D). Do not make a large fillet extending to the outside diameter of



bell. In entering the cement be very careful to completely fill the whole space. A wooden pusher, shaped something like a yarning tool, is useful for pushing back the cement after it has been entered by the hands. Sometimes a roll of yarn is used to drive the cement back, the yarn being withdrawn, more cement entered and the process repeated until the desired quantity has been entered.

After the first yarn is in, and before the joint is made, the pipe should be thoroughly bedded and tamped in between the bell holes, to prevent any movement of the joint after it is made.

When the joint is made, it should be protected from the sun. As few joints as possible should be made in the rain.

All joints should be tested before being covered up. The best test is made by connecting gas pressure to the new pipe, through a meter, thus measuring the amount of leakage, if any. If the meter indicates leakage, the holes should be found by using soapsuds on the joints. Fire should never be used. The joints should be tested only after the cement has set sufficiently to prevent its being hurt by the soapsuds,—where feasible, this should be on the following day.—*Com.*

JOINT No. 2.

“In the sketch enclosed Fig. 2 is a side view of a 6" cement joint, with part of the hub removed, showing cement and packing. In the sketch C is the cement, P packing. After the pipe has been ‘sent home,’ graded, and the joint equalized as near as possible, one inch of hemp packing is firmly driven in as shown—Fig. 1. Then one inch of cement and one inch more of packing, followed by one and one-half inch of cement, of which one-half inch is on the outside of hub, and slopes from center of rim down to pipe as shown—Fig. 2. To make this joint requires $3\frac{1}{2}$ pounds of cement and sand mixed dry; 2 parts of cement to one of sand, and 3 ounces of hemp packing. The joint can be made in 15 minutes.”

11. What is naphtha?

What is crude oil?

What is gas oil?

Ans. The name “naphtha” is a general term applied to the products of petroleum distillation coming from the still after gasoline, and before the so-called “refined” or “lamp oils.” It is volatile at atmospheric temperatures and is colorless. Its specific gravity is from .680 to .740—water being 1000.

“Crude oil” or petroleum, is a natural oil found, generally in the crevices of rocks—whence its name—“petroleum,” meaning rock oil. It is a mixture of several liquid substances of different gravities and chemical compositions. It is separable into these substances by distillation. It is found in nearly every country of the world, and is a commercially important product in the United States, Russia and Peru. The gravity of crude oil, or petroleum, as produced in Pennsylvania and Ohio, is from .80 to .85. It is of various colors, but generally it shows dark claret colored by transmitted light. By reflected light it is generally greenish.

"Gas oil" is the name applied to a product of the distillation of petroleum. It is a "straight run" oil; that is, it is all the oil that comes from the still between certain temperatures, and is not a mixture of several separate products. Its specific gravity varies within wide limits, but will probably average about 84. Its color varies from quite light to very dark, and does not indicate its value for gas making purposes—*Com.*

12. How do you determine when the checker brick in your water gas apparatus needs cleaning?

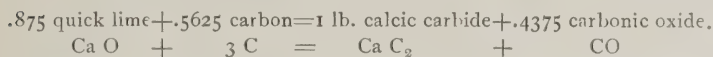
Ans. The checker bricks of a water gas apparatus should be removed and cleaned, or renewed when dirty or crushed, or disintegrated. Checker bricks may become covered with a non-conducting coating of ashes or carbon, or both, making impossible the desired exposure of the oil vapors to properly heated brick surfaces. When bricks are coated or saturated with carbon the surface heats rapidly, because the carbon burns, and the gas maker is deceived by the glowing carbon and believes the bricks to be hotter than they are. It is possible to tell something of the condition of the checker bricks by observation through the sight cocks provided for the purpose. Other indications of dirty bricks are a falling off in the rate of make per minute and in the oil results. If all the conditions of operating remain unchanged, and the candle power falls materially and stays down and the make of gas per minute of run is reduced, the checker bricks should be at once examined and, if dirty, cleaned or removed. Bricks should not be allowed to become so fouled as to make a material reduction in the rate of make. Experience soon teaches an intelligent gas maker to avoid both the extreme of reduced results and of too frequent cleaning—*Com.*

13. Give a brief description of calcium carbide, and of acetylene, and their properties.

Ans. Calcic carbide, or carbide of calcium, as it is popularly called, is a heavy, hard, gray crystalline substance, composed, by weight, of 40 parts of calcium and 24 parts of carbon. Its specific gravity is 2.262. It has a strong affinity for water, and when exposed to the atmosphere absorbs moisture, giving up acetylene gas. (See formula below.)

Calcic carbide is formed by the union of calcium and carbon, fused in the heat of the electric arc. The calcium is used in the form of quick lime, and the carbon as powdered coke, coal or charcoal.

The reactions occurring in the production of calcic carbide, are:



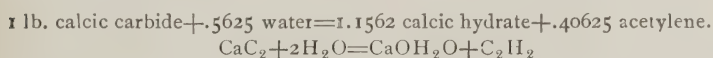
Acetylene gas is, chemically, an unsaturated hydrocarbon of the series $\text{C}_n \text{H}_{2n-2}$. Its formula is $\text{C}_2 \text{H}_2$, and it is composed by weight of 24 parts carbon and 2 parts hydrogen.

It is a colorless gas. It has a strong garlic odor. Its specific gravity is .91. Its weight per cubic foot is .07 lb. Water at 60°F . will absorb about its own volume of $\text{C}_2 \text{H}_2$. It burns with a highly luminous flame. Its illuminating power is approximately 240 candles for five cubic feet.

When unmixed with other gases or with air, it must, in order to develop its full illuminating value, and prevent smoking, be burned through small flat flame burners. It is very rich in carbon, and the flame smokes when large burners are used.

It is present in coal gas to a fraction of one per cent., and in a somewhat higher proportion in illuminating water gas. It is formed during the incomplete combustion of illuminating gas. This occurs when the flame of a Bunsen burner "flashes back," the gas burning within the burner.

The present important source of acetylene is calcic carbide. When water is brought in contact with calcic carbide acetylene gas and quick lime are formed, according to the following formula:



One pound of pure calcic carbide produces .406 lb., or 5.8 cubic feet acetylene.

Acetylene burns to water vapor and carbonic acid—*Com.*

June, 1897.

THIRD SERIES OF QUESTIONS FOR THE PRACTICAL CLASS OF THE AMERICAN GAS LIGHT ASSOCIATION—1897.

1. What is meant by the statement—"The tank was rendered with neat cement?"
2. Describe the preparation and use of cement mortar for brick work construction, with precautions to be observed to insure strength and uniformity.

3. Does coke deteriorate while stored? If so, why and how?
4. It is desired to put into service the full depth, regenerative retort bench let down in Question 5, Series 2. Describe the process up to and including the drawing of the first charge burned off.
5. Describe the principle and action of some form of gas governor.
6. What is meant by the statement—"The specific heat of a certain substance is .750, or is three-quarters that of water"?
(The Committee desire to emphasize the importance of a thorough understanding of the laws involved in the solution of heat problems. Any student who has not an understanding of Problem 7, Series 1, and of Problem 7, Series 2, is recommended to give them further study.)
7. Make a sketch of a dry centre valve for four purifying boxes, built to put three in action at one time. Show the divisions of the seat and cover, and describe the action of the apparatus.
8. What is the common method of manufacturing sulphate of ammonia; and what are the chemical reactions that occur in the process?
9. What is "coal liming"? Give its purpose, and its effect on the impurities in the gas, and on the residuals produced.
10. What is a paint?
" " " varnish?
11. What is oxidation?
" " " combustion?
12. Why are scrubbers for the removal of ammonia filled with coke or slats?
13. Describe the cleaning of a water gas washbox, including the precautions to be observed.
14. If you have no knowledge of water gas apparatus, omit question 13, and describe the cleaning of a badly stopped standpipe.

(This Appendix to the Committee's Report was not read at the meeting.)

THE PRESIDENT—You have heard the report of the Committee on Education. I think that you will agree with me that this is a magnificent work, and when you realize the spirit in which it is undertaken and the amount of work that this Committee is doing I think you will all, as the officers of the Association do, take a

great deal of pride in the fact that it is being done under the auspices of this Association. If you will bear with me for a moment I would like to explain something of the work which this Committee are doing; very likely you are already familiar with it, but it did not strike me until the last two weeks how much labor they are putting into this matter. They are sending out three, and intend this year sending out four sets of papers, each one comprising twelve or thirteen questions. The class averages fifty members and, consequently, they are obliged to examine on each set of questions, 600 answers. And not only that, but then they must formulate their own answers – and to my certain knowledge there have been answers given by the Committee on which hours have been spent, and this is done solely to help those in the business who want to be helped. Personally, I am very proud of this work and I am sure that that must be the feeling of the whole Association. What will you do with the report of the Committee?

MR. GREENOUGH—I move that the report be accepted, that the thanks of the Association be extended to the Committee, and that the Committee be continued.

Seconded, put and carried.

THE PRESIDENT—I am informed that the Committee on Research will be ready to report to-morrow, and the Committee on Nomination of Officers this afternoon.

MR. GREENOUGH—The Committee on Nomination of Officers will report either this afternoon or to-morrow.

THE PRESIDENT—The next business is the address of the President

PRESIDENT'S ADDRESS.

Once again the season that brings us together has arrived, and, as we exchange greetings, it does not seem possible that 12 months have passed since we met in St. Louis. The years roll around rapidly, too rapidly for many of us, and the speed seems all the faster because we are so busy that most have neither time nor inclination to count the days or the months. And yet, in spite of the rush and bustle of our daily lives, which give few of us time to do our work as carefully or as well as we would like, in spite of this we individually and collectively make progress. The business as a whole advances and we advance with it. It may not be definite and distinct year by year, but compare this year with five

or ten years ago, and it can surely be said that more gas is made and sold than then, that it is as good a gas or better, that it is produced cheaper and sold cheaper, and that the whole practice, or science if you will, of gas manufacture, is better understood and better worked out than ever before. Twenty-five years have elapsed since the meeting preliminary to the organization of this Association was held, and at this, our twenty-fifth annual meeting—our silver anniversary—it may not be amiss to note a few of the changes in that time. There are probably quite a number present who were selling gas in 1873 for \$4.50 or \$5 per 1,000 feet, and who will remember how unpleasant it was to collect the bills at that price; and the same gas, or rather a much better gas, is now generally sold from \$2 down to \$1, and in a few cases at even less than that price. To be sure, our coal then cost \$8 or more, and now less than half that sum, but our labor is paid fully as much, and, on the average, I believe, more. A yield of 6,000 feet per retort is now replaced by 9,000 and 10,000, and in some cases by 11,000 and 12,000 feet, and the yield of gas per man has increased from 15,000 to 25,000 feet, and, with labor-saving machinery, to 50,000 feet. Water gas, with its brilliant white light, was not in use, except in the famous “deserted village” in the city of Brooklyn. The electric light was not, either as a competitor to worry us, or as an ally to help us by educating the people to the use of more light. Yes, times have changed indeed, and, we hope and believe, for the better. In this address I shall not attempt any general review of the field of gas engineering, but confine what I have to say to a few comments on some of the events of the year, and on a few matters that are now attracting more than ordinary attention.

One of the most encouraging matters connected with our Association, as indicating its strength and vitality, is the work of the Committee on Education. That they have done for the past two years, and are doing, a most excellent work, no one will gainsay. I doubt if any gas engineer or manager of a gas works in this country can read over the questions sent out to the class, and the replies finally made up by the Committee, without getting some information, and if that be true, what must it be to the students, most of whom are young men with comparatively few years of experience. I am informed that the class averages about 50; that most work faithfully and conscientiously on the questions sent out, and that the interest in the work increases rather than diminishes. If this work

be kept up, as we all hope it will, through a series of years, it can but result in giving the gas companies of this country a much more intelligent body of men as engineers and managers than they otherwise would have. As most of our membership know but comparatively little of the work of this Committee, I hope I will be pardoned, and I trust I will not be misunderstood, if I say a few words of a personal nature. The Committee is made up of some of the busiest men among our members, and when we consider the work involved in preparing the questions, the examination and marking of the replies, and the preparation of the answers of the Committee—in some cases involving several hours' work on one answer alone—it will be understood what an enormous amount of time some among the members of this Committee are giving; and for what purpose? I am sure the one feeling that animates their work, that dominates everything else, is to help those who want help; to raise the standard of intelligence among gas men, and to give the man, who for reasons beyond his control never had an opportunity to receive a technical education, a chance to do better work—a chance to rise. I am sure I but voice the sentiments of the entire membership of this Association when I say that we are, both as an association and individually, under great obligations to this Committee, and especially to its Chairman, Mr. Walton Clark.

Since we met a year ago a gas exposition has been held in the city of New York, which certainly exceeded the expectation, and I think even the hopes, of the gas people of the country. It was not only a collection of much that goes to make up gas works and everything through which and by which gas can be consumed, but it was also a magnificent display of the possibilities of gas for lighting. Too much credit cannot be given to the gentleman, Mr. E. C. Brown, who conceived and engineered this scheme to a successful issue. The gas companies of the whole country are certainly under obligations to him.

During the past year fuel gas has attracted some attention, particularly in the State in which the speaker resides. An attempt was made at the last session of the Legislature to obtain the right to run gas pipes throughout the more populous parts of the State, in one case a distance of 56 miles, supplying not only isolated houses and factories, but villages and cities that might lie in the track of these pipe lines. Through these pipes it was proposed to distribute illuminating and fuel gas, how, I never understood, except

that the gas was illuminating gas pure and simple. These applications were opposed, of course, and as the fight before the Legislative Committee progressed the pipe line matters were dropped out of sight, and the main issues were confined to two points: first, to obtain the right for a fuel gas company, already established and doing business in the city of Bridgeport, to distribute illuminating gas, thus tacitly admitting that it was quite desirable, if not necessary, to sell illuminating gas in connection with a fuel gas business.

The second was in the city of Hartford, where an attempt was made to introduce an opposition company, laying two pipes in one ditch, one to carry fuel gas and the other illuminating gas. The testimony was largely on the value of fuel gas, which in this case was a non-luminous water gas of 300 heat units. A vigorous fight was conducted; but happily, as it seemed to those of us who were in the "opposition," the applications were defeated.

Probably the promoters in this matter are as well posted as any body of men in that branch of the gas business, and yet the following statement, gotten up by one of the experts employed, Mr. Eugene Vanderpool, would seem to convince, "beyond the shadow of a doubt," the most pronounced water-gas fuel-gas enthusiast that he must be mistaken, and that the road to success in fuel gas matters does not lie along the line proposed:

A gross ton of coal contains, in round figures . . . 31,000,000 heat units.
When put through the plant in question it produces 50,000 feet of gas of 300 heat units per foot . . . 15,000,000 heat units.
Loss in going through the plant, over . . . 50 per cent.

Figuring in the same way, a ton of coal put through a coal gas works will contain 31,000,000 heat units, and will produce:

11,000 feet of gas of 650 heat units per foot, or . . . 7,150,000 heat units
1,200 pounds of salable coke (under the best conditions of regenerative furnaces) at 14,000 heat units per pound . . . 16,800,000 heat units.
130 pounds of tar and 180 pounds of ammoniacal liquor, and their cash value, is greater than the weight of coal they represent. Inasmuch as this gives a gain economically, it is fair to charge up their actual weight at least in heat units—310 pounds at 14,000 . . . 4,340,000 heat units.

Total heat units available for use . . . 28,290,000 heat units.
A loss of 2,710,000 heat units; or 8.74 per cent.

Could a more convincing theoretical argument be brought forward, that if one is determined to distribute fuel gas, as between the two, illuminating coal gas can probably be made with less waste of energy than blue water gas. Starting with a loss of one-half of the energy of the coal, add to it the labor in production, wear and tear, cost of distribution and interest, and it would seem as if a gas could not be sold at a price, as compared with the cost of coal, that anyone could afford to pay, except for very small quantities and for intermittent use.

For corroborative testimony from a practical standpoint, I cannot do better than to refer to the remarkable paper on this subject, by Mr. F. H. Shelton, read before the Western Gas Association in May, 1897.

This is, of course, a one-sided statement in regard to the matter, and perhaps I have not done justice to the claims in favor of blue water gas; but, after hearing all that was said for and against fuel gas in the legislative hearings above referred to, I am more than ever convinced that the only fuel gas that will ever be distributed and sold in a general way, and at a profit, is that which is made by an illuminating gas company, and the product must be illuminating gas.

The use of the incandescent gas lamp grows apace, both here and everywhere else throughout the world; and what a blessing it has been to the gas consumers and to the gas companies—and, I might add, what a gold mine to its owners. It has reduced the cost of using gas by one-half, and it has more than doubled the light. Its use in stores particularly has changed appearances so much that a Rip Van Winkle would hardly recognize our business streets in an evening, although no other changes had been made. During the past year competition has come in with our friends of the Welsbach Company, and to-day a good many burners are being put on the market. So far as the gas companies are concerned the trouble is that some of these competing burners are not as good as could be wished. The mantle does not last, and gives comparatively a poor light, and in consequence the consumer has, in his own estimation, "poor gas." So far as we can influence such matters, it ought to be in favor of the best burner, regardless (within limits, of course), of the cost of either burner or mantle. There are rumors of startling improvements on the other side of the ocean that we are likely to hear about more definitely during

the next twelve months; improvements both as to the life of the mantle and as to quantity of light obtained per foot of gas consumed.

In the matter of street lighting with incandescent gas burners some progress has been made in this country. I have been informed that the Welsbach Street Lighting Company, of America, have now in operation 2,700 lamps in 18 cities, and are rapidly increasing the number. In a recent issue of one of our gas journals the following statement was made: "The German Gas Association sent out inquiries in regard to the use of Welsbachs on the streets, and received replies that they were being used, to a greater or less extent, in 245 towns (presumably most of these towns are on the Continent), and in that number of places there were 61,569 Welsbach lamps in use out of a total of 287,721 public lamps." To those who have not seen a street lighted with Welsbachs I can only say that the effect can be made very fine. I have in mind a broad street with lamps along each curb, each containing two burners, and located, as my memory serves me, not over 100 feet apart. The result was an even, pleasant light, that was equal, if not superior, to the extravagant use of electricity on Fifth Avenue, in New York city. From the facts and figures given above it looks as if it was not impossible that the time would come when this form of street lighting might be very generally adopted.

At the last meeting of the American Association one of our members read a very complete paper on the use of inclined retorts and the benefits resulting from the same. So far as I know no construction of this sort has been erected in this country, but their use is extending rapidly in England and on the Continent. I have before me a list of seventeen gas works in England now using inclined retorts, and of sixteen gas works on the Continent, either using or having in course of construction 3,052 retorts on this system. In this connection I desire to call your attention to a short extract from the able address of Mr. Corbett Woodall, before the Incorporated Institution of Gas Engineers, at their May, '97, meeting. By reason of Mr. Woodall's large connection with gas companies in England and on the Continent, he is probably one of the best authorities on the subject. He says: "The introduction of the system of inclined retorts is an innovation heartily welcomed, and which is having, and will certainly continue to have, a wide acceptance. It is not necessary I should remind practical gas makers

that, while there are many and great conveniences attaching to this system, its possibilities of economy are limited. By its adoption, the proportionate number of workmen employed is greatly reduced as compared with hand labor, and is less even than what is required with an efficient system of mechanical stoking. It is possible also to carbonize a larger quantity of coal on the same ground area than with the system still generally prevailing. Further, as has been shown in several cases in England, and also in an admirable model which was shown at the last meeting of this Institution, it is possible to reduce the cost of houses inclosing inclined retorts considerably below their present cost for a given output."

With the most of our works in this country inclined retorts can never be used, owing to the comparatively small quantity of gas made, but in the larger works this reason does not apply, and with the low prices at which our excellent gas coals are sold it would seem as if it could not be long before the experiment would be tried here.

One of the facts of general business which has attracted more or less attention for years is that of a division of profits between the employers and the employed. It has been tried a great many times in various lines of work, and in several countries with more or less success. In a report made to the British Parliament on this subject there is given the history of a very large number of instances of profit sharing in Great Britain. Many of them have been abandoned after a few years' trial, working unsatisfactorily for various causes. It seems to be in the main satisfactory when there are profits to divide, but when there are none, naturally the satisfaction is not so great. In this country, so far as I know, it has been attempted by only one gas company, and the President of that in a recent letter makes the following statement: That he is now paying the same dividend in cash to his men on the amount of wages received by each employee as the stockholders receive on their stock; that when starting this plan it was made conditional that the dividends should be invested in stock until each person owned not less than three shares; that, so far as inducing the men to become stockholders, the plan had not succeeded; but that so far as it had made the men more happy and contented, had avoided strikes and had reduced the price of the manufactured product, he was entirely satisfied, and that he would not change it.

During the past summer the speaker met the one among gas men who perhaps is the most prominent advocate of profit sharing,

Mr. George Livesey, of the South Metropolitan Company; and, in brief, his experience is this: Starting in 1890, he has now introduced profit sharing among all the employees of the company, numbering about 3,000. This is based on a sliding scale, the amount of bonus or profit divided being determined by the price of gas, which, in turn, is supposed to be more or less under the control of the men, as they work well and faithfully, or the reverse. With an initial price of 2s. 8d. for gas, for each penny that gas is sold below that price the men receive $1\frac{1}{2}$ per cent. on their wages, up to 9 per cent.; after that figure is reached it is 1 per cent. for each penny reduction. As gas is sold for 2s. 3d., the dividend to the men is $7\frac{1}{2}$ per cent. Of this bonus one-half must be invested in the stock of the company. There is an alternative proposition by which a man may receive 1 per cent. instead of $1\frac{1}{2}$ per cent., and draw the whole amount in cash. In consequence, the employees of the company own to-day over \$200,000 of its stock; and in a letter to the *London Times*, relating to this matter, Mr. Livesey asks and answers this question: "What about the company? Have they received their money's worth? Unquestionably; yes, is the reply. During the whole period there has not been a single difficulty or any disagreement of the workmen. The work has been done better and in a more cheerful spirit, and it can be safely said the company is better off financially for the \$400,000 paid."

Recently in the *New York Tribune* a short editorial appeared, of which the following are extracts: "The policy of the Illinois Central Railroad Company, in encouraging its employees to buy stock of the company, paying for the same in installments, seems to have proved successful in more ways than one. Since the employees were invited to become stockholders, about four years ago, they have purchased and paid for nearly 2,000 shares, and partial payments amounting to nearly \$60,000 have been made on 1,624 additional shares. But more important than any pecuniary returns to the employees of the company is the fact that their ownership of the company's stock will do more than anything to allay possible irritation between them and the company. Both employer and employed will discover that their interests are identical, and that they will be equally benefited by any policy that helps to strengthen and enrich the road."

The ownership of stock is not in the line of profit sharing, but it aims at the same ultimate object—to give the employees a direct

moneyed interest in the success or failure of the corporation for which they work. It seems to the speaker that an ideal condition for any industrial corporation would be to have each employee a stockholder, and also receiving a sufficient amount from a division of the profits, so that in whatever move he made he should not be influenced by his work and his pay alone, but that he would be obliged as a matter of self-protection to consider the interest and welfare of the corporation. Such a condition brings both sides to the same point of view; and, with the same point of view for both employer and employed, labor troubles ought to be, and probably would be, at an end.

The prepayment meter has not attracted as much attention in this country as in England, and while meters have been introduced in quite large numbers in a few cities here, the majority of the companies have used them very little. I have it on good authority that the total number of prepayment meters in this country in use at the present time is about 40,000, and these have been placed practically in the last two years. In the judgment of the speaker they have not received the attention that they deserve. In the accounts of the proceedings of the associations in England and in the report of the annual meetings of the various companies in that country, prepayment meters have received for several years a great deal of attention, and have almost always had favorable comment. As you know, the Gas Light and Coke Company of London have placed 65,000 of these, and the South Metropolitan 61,000. Mr. Livesey told the speaker this year that the great thing in gas matters in England to-day, in spite of the fact that it was commenced seven years ago, was the acquiring of new consumers among the poorer classes by means of prepayment meters, piping houses, and furnishing gas stoves, free. Of course it is but fair to say that these companies invest nearly or quite \$30 for each prepayment meter consumer, but on the other hand they charge 20 cents per 1,000 feet above the regular price for all gas sold in this way, and each consumer of this class with a range averages 20,000 feet per annum. In an experience running over a year with these meters, the speaker can say nothing except in their favor, and earnestly recommends them to the careful attention of all companies who desire to increase their business. In his experience almost every meter has gained a consumer that with the ordinary meter could not have been obtained, and the ease with which the business is done—each

month's transaction being finished when the meter has been inspected and the money counted—makes it still more desirable.

There have been several times in the past few years when I would have been very glad to have known the average amount of gas sold per capita throughout the country, but I did not know where to obtain accurate information on the subject. Thinking that perhaps others might be in the position to need this information as well as myself, I determined to incorporate it, if possible, in this address; and to that end I have sent out within the past few weeks over 700 letters to gas companies in this country and Canada, stating my object and requesting a reply to the series of questions enclosed. Of that number about 400 have sent replies, and of these I have been able to tabulate 389. I desire to express my thanks to the gentlemen who so kindly answered the questions, and I can only hope that my labor in this matter will be of interest and value to others, as well as myself.

In arranging the replies I have divided them into three classes: places under 20,000 population in the first; 20,000 to 100,000 in the second; and 100,000 and over in the third. The averages of 238 places are given in the first; 129 in the second; and 22 in the third, and are as follows:

TABLE NO. 1—*United States and Canada.*

	Under 20,000 Population.	20,000 to 100,000 Population.	Over 100,000 Population.
1. Number of places	238	129	22
2. Population	2,452,041	5,373,476	6,599,650
3. Average population	10,303	41,654	299,984
4. Gas sold	2,302,383,073	7,916,568,875	15,809,553,800
5. Average Sales	9,673,878	61,368,751	718,616,082
6. Number of consumers	105,934	322,553	594,292
7. Average number of consumers	445	2,500	27,013
8. Average price	1.50	1.42	1.11
9. Total sold by meters	2,205,334,630	7,611,203,229	14,666,625,400
10. Average sold per meter	19,925	23,075	29,134
11. Average amount received per meter	32.08	32.33	32.04
12. Sales per capita, feet; average by number of places	961	1,348	2,190
13. Sales per capita, dollars	1.53	1.81	2.47
14. Sales per capita by total quantity sold, and total population	939	1,473	2,395
15. Percentage of meters to population	4 $\frac{3}{10}$ per cent.	6 per cent.	9 per cent.

All the averages, except those contained in line No. 14, are made up upon the basis of the number of towns in each class. I desire to call your attention to a peculiar circumstance that the average amount received per meter (line No. 11), is between \$32 and \$33 in all three classes. This may be purely accidental, but I am inclined to think that this amount represents the average amount that can be collected per meter. The sales per capita (line No. 12) increase very rapidly with the population; and if another class had been made of cities of over 500,000, I am confident that the sales per capita would have been very much larger than in the other three; but there were so few replies received from cities of this size that it would probably have been misleading to have done so with the information in my possession. In the preparation of this matter I have naturally given it considerable thought, and it has seemed to me that the sales per capita did not express the information we were really seeking. While the gas sold per capita is interesting, and for the purposes of comparison instructive, yet that quantity is, of course, affected to a greater or less extent by the price charged; and the real thing, the keynote of this particular subject, is the amount of money received per capita—the gas sold multiplied by the price charged—and you will notice that I have given averages on this point (line No. 13), and they also increase with the population, although the price is lower in the larger places. I desire also to call your attention (line No. 15), to the relation between the number of meters and the population, expressed in percentage, which also shows the higher figures for the larger places. Combining all of the 389 places together, we have a population of 14,425,167 with an amount of gas sold of 26,028,505,748 feet, and an average sale of 1,804 feet per capita.

Through the kindness of Mr. Norton H. Humphrys, of Salisbury, England, combined with information obtained from "Field's Analysis" for 1896, I have been able to place before you some results obtained in England. These I have grouped in three classes, by population, as in Table No. 1, and they are as follows:

TABLE No. 2—*England.*

	74	8 (included in 16)			21	London.
		16	8	21		
16. Number of places.....						
17. Population.....	1,048,600	650,000	434,000	6,807,000	5,000,000 (Assumed).	
18. Average population.....	14,170	40,625	54,250	324,142		
19. Gas sold.....	3,293,836,000	2,873,120,000	2,051,748,000	29,940,437,000	30,462,170,000	
20. Average sales.....	44,511,295	179,570,000	256,468,500	1,425,735,095		
21. Number of consumers.....			41,577	761,441	448,047	
22. Average number of consumers.....						
23. Average price.....			5.197	36,259		64
24. Total sold by meters.....			.70 1/2	.59 1/2		.626
25. Average sold per meter.....			1,875,770,000	27,749,686,000	28,828,973,000	
26. Average amount received per meter.....			47.469	43,625	64,344	
27. Sales per capita, feet; average by number of places..	3,178	4,614	34.03	26.42	40.28	
28. Sales per capita, dollars.....			5.457	4.797	6.092	
29. Percentage of meters to population.....			3.49	2.83	3.81	
			9.58 per cent.	11.19 per cent.	8.96 per cent.	

You will notice that the averages are nearly all larger except the prices charged, and those are much lower. With many others I have always hoped that we could some day sell here the same quantity of gas that is sold in England; but I am free to confess that the more I investigate the subject the more remote becomes the possibility of such a result. In winter the lighting hours at night are longer, and the cloudy days more numerous than in this country; and in the summer, while the lighting hours are shorter, owing to the higher latitude, and the cloudy days approximately the same, yet the greater heat of this country tends to lessen the amount of gas consumed for light; and yet it is warm enough in England, combined with other causes, to induce an enormous number to use gas stoves. To these reasons add the low price at which gas is sold—which I doubt if we can ever reach—and it seems as if sufficient cause had been shown why more gas is and will be sold in that country than in this.

In this connection I desire to call your attention to the sales of gas in London, on fifth column of Table No. 2. The figures given, except as to population, are taken from "Field's Analysis" above referred to. The population, as given in "Whittaker's Almanac," is something over 4,400,000, but I am told the London companies reach out so far beyond the city limits that that number would be incorrect. I have, therefore, assumed an arbitrary figure of 5,000,000, which, of course, is only approximately correct. I desire only to call your attention to the enormous amount of gas sold, the large consumption per meter, and the very large sales per capita. Combining columns 1, 2 and 4 of Table No. 2, the totals are as follows:

Number of places.....	111
Total population.....	8,505,600
Total sales.....	36,107,393,000
Sales per capita.....	4,245 feet.

In the German *Gas Journal* of July 17th, 1897, there appeared an article by Mr. Emil Merz, of Cassel, Germany. In it are elaborate tables showing the consumption of gas in a number of cities in the years 1895-96. From these tables it appears that the average sale per capita in 77 German cities is 1,830 feet.

To recapitulate: The average of gas sold per capita, from the above tables, appears to be in—

The United States.....	1,804 feet.
Germany.....	1,830 “
England.....	4,245 “

Four deaths have occurred during the past year: Mr. Joseph R. Thomas, the Editor of the *American Gas Light Journal*, who has met with us so often, and who was so well-known and so much liked by nearly all the membership of the Association; Colonel John W. Newell, the Secretary and Engineer of the Gas Light Company, of New Brunswick, N. J.; Mr. Frederick W. Norton, Superintendent of the Nashua Light, Heat and Power Company, Nashua, N. H., and Mr. Joseph D. Weeks, the Editor of the *American Manufacturer and Iron World*, of Pittsburg. Mr Norton's death occurred only October 2d, 1897, and the week before he was in Boston making arrangements to come to this meeting.

While we shall miss these gentlemen from our ranks, yet I think we can congratulate ourselves that the number is so small, and that as these vacancies occur their places are being filled, and well filled, and the work of the Association will go on.

The holding of this meeting at Fortress Monroe, in what has been described by some as an “out-of-the-way” place, is an attempt on the part of those who voted for it to meet away from the large cities, and incidentally to avoid placing the Association in a position where the local gas companies and supply people would feel compelled to extend hospitalities and courtesies. The matter is an experiment. For one I do not feel sure that our meetings, if held outside of the large cities, can be made as successful as they ought, but there is so large and so respectable a minority, if not a majority, who would like to see the experiment tried, that I would suggest that for a year or two the meetings be held away from the large places. If it be found that the attendance and interest lessen, surely those who favor the idea which controlled the location of this meeting will acquiesce in changing back to the old plan. In this matter, of course, the majority must rule, and all that any of us seek is the greatest good for the Association.

And now, gentlemen, I have nearly finished; the meeting is in your hands to make of it a success or failure. I believe there can be no question which will be the result. Thanks to the earnest

efforts of a number of gentlemen, and to the pleadings of your Secretary, a list of papers has been prepared for this meeting that will, I think, compare favorably with those presented at any previous meeting of our Association. I would urge that each member make it his duty, and I trust it will be his pleasure as well, to attend promptly the sessions of this meeting, and by giving strict attention to the papers show an appreciation of the work of the gentlemen who have tried hard to make the literary programme a success.

For myself I can only thank you for the great honor that you have done me in electing me your President. It goes without saying that to be President of an Association in which my father took so much interest, and for which he worked so earnestly, and so faithfully as Secretary, is a source of very great pleasure. I believe that my election to fill this high office must have been due in large measure to the kindly feelings of his friends as well as my own. Whatever the cause I thank you, gentlemen, heartily and sincerely.

MR. WHITE—I move that the address of the President be referred to a committee to be appointed by the Chair; and further that the address be published as a separate pamphlet and circulated among the members. It is an excellent paper, and we do not want to wait to get it in book form. We all know how much more useful it can be if published as a pamphlet than to take the *Gas Light Journal*, or other journals, as the source to which we must refer when we wish to look up any of the matters touched upon in the address. I therefore wish to include that in my motion—not only that a committee of three be appointed by the Chair to report upon the address, but also that the address be immediately published by the Secretary as a separate pamphlet.

VICE-PRESIDENT HUMPHREYS—We have listened to a very instructive address, and one from which we can all gain benefit by study. It must have taken much time, much study and much research to compose the address. It gives me great pleasure to put the motion. (Carried.) The Chair will appoint as that committee Captain White, Mr. Jourdan and Mr. Cowdery.

MR. WHITE—While I recognize the courtesy shown by naming me on that committee, the Chair will also recognize the fact that I have already a great many duties devolving upon me as Chairman

of the Committee of Arrangements, and I really do not believe I could do the address justice in any report that I might take part in making. I would be very glad to serve if I could do so, but under the circumstances I beg to be excused.

VICE-PRESIDENT HUMPHREYS—The Chair accepts the apology, and will appoint as the committee Mr. Cowdery, Mr. Jourdan and Mr. Prichard.

THE PRESIDENT—We shall have ample time before adjournment to have a paper read, and unless there is some business which some member would like to bring forward I will call on Mr. Mitchell to read his paper entitled “A Method Successfully Employed to Obviate Trouble from Naphthaline.”

(For this paper see Appendix, page lxii.)

THE PRESIDENT—We have listened to a good paper, on a very important matter. It would certainly seem as if Mr. Mitchell had gone a long way towards solving a very difficult subject. Will Mr. Ramsdell start the discussion?

MR. RAMSDELL—It seems to me that there is very little that I can say upon this topic, although I have had a great deal of experience with naphthaline. Very evidently in the case at St. Joseph this treatment has been successful; and as success is the principal object in view I see no good reason why it should not be as successful elsewhere as it has been at that point. I presume (although Mr. Mitchell does not say so) that in passing this gas through a two-inch pipe from point to point, the size of the pipe chosen was selected in order to obtain the percentage that is required to make this work most successfully. It has struck me more particularly than any other feature of the work that this pipe was small. The passing of the gas in this same manner is, of course, an old feature, but I have never known or heard of its being done for the purpose of removing naphthaline before. But inasmuch as it has proven perfectly successful, and inasmuch as it is an extremely inexpensive experiment to try, it seems to me it is one of great value to all of us. We have all been troubled with naphthaline, so that we know just what it is, and what it means, and any remedy, no matter how difficult or how expensive, which would entirely eradicate naphthaline troubles would be valuable. In this instance, however, it seems to me of great value from the fact that

it not only eliminates the troubles from naphthaline, but at the same time adds $1\frac{1}{2}$ candles to the lighting power of the gas. That is a feature which is certainly very important.

MR. W. FORSTALL—I would ask Mr. Mitchell whether he found it necessary to raise the temperature of the returning gas, also what was the size of the works' connections.

MR. MITCHELL—The temperature at the exhauster was about 100° . We did nothing to raise the temperature of the returning gas, but just took it as it came through. The connections were 16 inches. The size of the pipe returning was about the right size in order to give us the right per cent. of gas returning.

MR. LITTLEHALES—I would like to ask the gentleman if he has made any observation whether or not it is not the elimination of the moisture from the gas, taking out the water and steam, that enables it to take up the additional hydrocarbon? I have read a great deal of what has been done in that direction, and it seems to me that one of the most important features of it is that the gas, having gone through the condenser and deposited a good deal of its moisture, is then in a better state to carry the hydro-carbon because of being relieved of the moisture. I think that a good deal of the secret of the success is in the direction I have indicated.

MR. GREENOUGH—I would like to ask Mr. Mitchell whether the coal which he has used is the same at all times, and whether the yield which he has obtained per bench of coal has remained the same during this experiment, and what it is?

MR. MITCHELL—In reply to the first question I would say that the gas was passed through a very small portion of the condenser; that is, we had our condenser arranged so that we could get a larger or a smaller proportion to the condenser. We tried to have our gas pass through as little condenser surface as possible, as we think that the condensation of gas has a tendency to rob the gas of benzole, and we reduce the capacity of the condenser so as to have the gas at about 100 degrees at the point of exhaustion. In reference to the coal I would say that we use coal which comes from southern Kansas, and yields about 8,000 feet per ton of coal. This coal contains a great deal of sulphur, but the candle power is possibly a little better than that of the Pittsburg coal.

MR. A. E. FORSTALL—It seems to me that in this experiment Mr. Mitchell has been doing to a certain extent what a good many

of us who have been happy enough to possess a water gas auxiliary plant have been doing for quite a number of years during naphthaline time. I do not know how it is managed with water gas made by a Lowe plant, but with our Wilkinson plant about the end of August or the 1st of September, which was our most critical period, when we saw indications of naphthaline around the works, or had any complaint from the districts, we immediately put a little more gas through our retorts and instead of fixing the oil as thoroughly as was necessary to get the best candle power results, we sacrificed candle power in order to save complaint and trouble on the street, thinking that we saved money by doing it. And in doing this we merely allowed a little light vapor to go through unfixed, and as the gas was mixed with coal gas before it passed into the purifiers, our idea was that this oil vapor, which possibly condensed before it got to the consumer, held the naphthaline in the gas until it did condense, and then dissolved it and kept it in solution so that it would not crystallize. Of course Mr. Mitchell has made a further gain by increasing his candle power. We did not get an increase in our candle power, having to use more oil to keep it up, but it would seem that the principle is about the same thing. We added vapors to our coal gas, which had naphthaline in it, and which was liable to give us trouble, and so carried this naphthaline along; and if it did condense, the vapor condensed out at the same time and kept the naphthaline in solution. Mr. Mitchell succeeded in doing this without an auxiliary water gas plant and purely with coal gas. A process has recently been patented in England for doing somewhat the same thing. The patentees propose to manufacture a lot of gas by getting high yields out of the coal, using a high temperature, and then to mix it either with rich gas made from rich coals distilled at a low temperature, or with gas from hydro-carbon oils distilled so as to carry vapor with it. In this way they claim that if the naphthaline does come out, the vapors from the rich gas will come out at the same time; and instead of the naphthaline crystallizing and causing an obstruction, it will be held in liquid solution and carried to the nearest drip to be pumped out there.

THE PRESIDENT—I think that Mr. Sherman can give us some interesting experiences with naphthaline.

MR. F. C. SHERMAN—I have had some very disastrous experiences with naphthaline, but I am very happy now to say that we

have found a remedy. Quite a number of gas companies in our vicinity are introducing vaporized naphtha into outlet of holder. In our own case we put it in through a coil which is heated ; and we use the same quality of naphtha that we are using in making our water gas ; and where we were at this time of the year having some 200 to 250 complaints per day, we are having hardly any at the present day, and when I came away I do not think we averaged half a dozen. We did not start the vaporizer soon enough this autumn, and before I got on to it we had from 120 to 150 complaints a month ago.

MR. GREENOUGH—Where do you put in the naphtha ?

MR. SHERMAN—I put it in at the outlet of the holders.

MR. GREENOUGH—How much do you put in ?

MR. SHERMAN—We succeeded in putting down the trouble last autumn with one barrel per day, and that is all we are putting in at the present time. We introduce it when we turn on the full pressure for evening consumption, and one barrel a day accomplishes the object.

MR. GREENOUGH—Do you vaporize it before you put it in ?

MR. SHERMAN—Yes. In our case it has proven to be a remedy. I would like to have Mr. Slater state his experience, as he uses the same plan, and quite a number of gas companies in New England have adopted it. It is not new. We first began doing it after reading an article in the *American Gas Light Journal*, written by Mr. Yorke, of Portland, Maine. We were very much annoyed with naphthaline. It went into the fixtures and we had continual complaints, and we were constantly obliged to blow out the fixtures for consumers, but so far this fall there has been no special trouble.

MR. R. YOUNG—How much are you sending out ?

MR. SHERMAN—We are sending out about 900,000 feet at the present time.

MR. R. YOUNG—And one barrel will answer for 900,000 feet ?

MR. SHERMAN—Yes.

MR. SOMERVILLE—I think we ought to congratulate ourselves that we have at last found a remedy for naphthaline. It is not a trite subject by any means. We all anxiously hope that we will never have to discuss it again. We must thank Mr. Mitchell or Mr. Shadbolt—I do not know which ; both probably—for finding

this remedy. It is an anxious time with us in August and September when we see the foremen going over and looking at the gauges as if expecting something, and not knowing exactly where it will come from. We very seldom get it in the burners of our consumers, but it seems to lodge just at the works. I have noticed that a difference of ten degrees in temperature, that is, a sudden fall of ten degrees, is enough to produce these interesting crystals in our drains! Did I understand Mr. Mitchell to say that this Kansas coal which he uses contains as much benzine and light oils as the Pittsburg coal?

MR. MITCHELL—I cannot say as to that, but the production of tar is about the same in the Kansas coal as it is in the Pittsburg coal.

MR. SOMERVILLE—Is the candle power about the same?

MR. MITCHELL—Yes, and the quantity of tar produced is about the same. I have never made an analysis of it, but I would take it that the production of tar is about the same.

MR. SOMERVILLE—So that you would be just about as successful in making naphthaline with the Pittsburg coal as you would be with the Kansas coal?

MR. MITCHELL—I should say so.

MR. SOMERVILLE—My remedy has simply been to add the vapors of naphtha to coal gas at these points, and if it was very stubborn, to go in with a scraper and take it out. I tried this oil business a year or so ago and introduced it by running a small pipe into the retort after the charge was burned, and put in a few gallons of oil every day. That certainly took out every trace of naphthaline, or carried it on, but I was astonished after keeping it up for a few weeks to find my liquor in the ammoniacal liquor scrubber change color. It looked as if it was full of tar. In fact I could not work it, and I had to stop. This vapor seems to get along and clog up everything. I could not work up my liquor because of the presence of tar. When I ceased using the oil in that manner the liquor went back to its normal color. So that, like the gentleman who spoke last, I have been putting a little vapor in the inlet to the meter, and that seems to answer the purpose.

MR. JENKINS—I would ask Mr. Mitchell what amount of condensing apparatus he has for the maximum measure, and what style of apparatus?

MR. MITCHELL—The condenser is a multitubular condenser; it is about four feet square, and is about the capacity that I am supplying for gas now.

MR. JENKINS—What is its condensing capacity?

MR. MITCHELL—I do not remember just exactly the condensing capacity per thousand feet, I have not the figures with me. It is about 16 feet high and 4 feet square, with $2\frac{1}{2}$ inch tubes.

MR. JENKINS—I asked that question for this reason: we have had naphthaline, and we have had plenty of it, and I attributed the greater part of our trouble to a lack of proper condensing apparatus. According to the usual way of figuring it, we have only about one-half the amount of condensing apparatus that we should have. I have attributed a great deal of our trouble to that fact; and I wish to find out if I can whether that is the matter. A friend of mine was last year afflicted very considerably with naphthaline, and I was asked the question what to do. I thought at that time that I knew all about it, and I told him that the first thing for him to do was to double up his condensing apparatus. He did that, and then he also added vaporized oil, and he got rid of it. But now I have more than I know what to do with, and I don't know anything about it. I want to find out about the condensing apparatus. We are introducing in the inlet to our gas holder a scheme similar to that of Mr. Sherman's, except that I have a tank 4 feet in diameter and 24 inches deep. 15 inches from the bottom I have a hot plate which is 2 inches in diameter less than the inside of the tank. Under this hot plate I have a coil of steam pipe. I drip the oil in through the center at the top of this box, and what does not vaporize by the heat from the steam coil will vaporize as soon as it strikes the hot plate. As tending to show that the oil which I use is thoroughly vaporized I may say that I get hardly a drop at the gas holder, or no more than we usually had when using 74 gravity oil. It has not entirely obviated the trouble with naphthaline, but I believe that it has gone a great ways towards it, as we have only a limited number of complaints at the present time. But still we are not entirely satisfied, but are trying to get rid of all.

MR. EGNER—During the past spring I had the honor to be present at a meeting of the Incorporated Institute of Gas Engineers of London, and there heard a paper read which gave a rem-

edy for naphthaline. Unfortunately I do not remember the name of the author of the paper. The idea was to inject sprays of light oil under pressure at the outlet from the holder. It was described as being done by using a small force pump, which introduced the oil in the shape of cold vapor at the outlet to the gas holder as the gas passed into the city. As nearly as I can now recollect about from four-tenths to half a gallon of oil per ton of coal carbonized was used. The claim was made that it not only enriched the gas from $1\frac{1}{2}$ to 2 candle power (which seems almost impossible considering the small quantity of oil used per ton of coal), but that it also entirely wiped out the naphthaline troubles.

MR. NEAL—I think this subject is one of the most important that can come before the Association. We have all been more or less troubled with naphthaline. We have had the same experience year after year, and I am very glad that my brother Sherman has now discovered a remedy. He has told me that he did not dare to introduce the subject before the Association, because it was such a “chestnut,” and sometimes he thought that we would almost mob him for speaking of it; but now he has found a remedy, and I am very glad that he has. I have been troubled with naphthaline from year to year, and some years, although using the same condensing apparatus, I have had very little trouble. I remember that our esteemed friend (many of the older members may remember him) Mr. Edge, invented a mechanical method for preventing the accumulation of naphthaline in mains and in consumers’ services, and it was apparently a great success. That was many years ago. But it did not prove to be a great success very long, and its use was abandoned. I also recollect that Mr. Jones, of South Boston, (not the Mr. Jones now in San Francisco, but his father), also had a method, which was entirely mechanical, and consisted in the use of some revolving apparatus in a cylinder. He told me that that was a sure remedy for naphthaline. But it was not used long. This year I have been greatly troubled, as I have been in past years; and the trouble commences in September and continues into October. I am very glad to see that the calls for the removal of naphthaline, from consumers and others, have diminished from a great many in 24 hours down to a very few. The difficulty is passing away, but I have not done anything. So that I am even with my brother Sherman. He has tried many remedies, and the naphthaline has diminished greatly; I have tried nothing, and the

naphthaline is also diminishing greatly. Mr. Mitchell has only tried this method in his works, as I understand?

MR. MITCHELL—I have advised putting it into works adjoining our town, at Leavenworth. They had no naphthaline, but they put it in in order to enrich their gas; and the superintendent there said that the gas was enriched about one candle by the introduction of the pipe.

MR. NEAL—Do you manufacture water gas?

MR. MITCHELL—We do now; yes.

MR. NEAL—I would consider your method more efficacious if some one had tried that method some distance off—say 50 or 100 miles; because it may have proved a remedy with you (as I have found in many cases), while the same remedy applied to other works may fail. I think that the name of naphthaline should be changed. People ask me if we have any naphthaline in our pipes. Of course we do. They cannot understand what that naphthaline is. If we could give it the name of “Gas gripe,” it would be much more suggestive. It occurs with some members of this Association every year. Sometimes it skips a year or two. That is exactly like the gripe. I do not care so much about the naphthaline if it would only stay at the works. We could take care of it there, although it would be a very great trouble to us. But where it affects the consumers, it is worse, because they do not understand it. They report to the office that the gas is poor. It is a great inconvenience, and I think sometimes it even lessens the send out in the month of September. I think the best remedy is the injection of vaporized naphtha.

MR. R. YOUNG—I did not quite understand, after it is vaporized, how Mr. Sherman introduces it into the main?

MR. SHERMAN—I passed the vaporized naphtha into the 24-inch outlet main from the holder. I would like to state a very disastrous experience I had with naphthaline by reason of the introduction of steam into the base of our purifiers. A paper was read at a meeting of the Western Association by Mr. Butterworth, who has charge of the works at Columbus, which led me to make that experiment, and I introduced it there and I thought I was having very excellent results in the way of purification; and I had until I found that my main from the purifiers to the inlet of my holders

was giving back pressure, and when I came to examine it I found that it was full of naphthaline, crystallized in a form upon which the ordinary methods of removing it had no effect. Hot water would not remove it. I used gasoline, but nothing would remove it. Finally I had to use a pipe cutter, cut the pipe out in sections and drill the naphthaline out. Immediately on stopping the use of steam in the purifiers we had no further trouble with naphthaline at that particular point.

MR. LITTLEHALES—I would ask Mr. Sherman, or someone who has had experience in injecting vapors at the outlet of the holder whether they have observed any tendency to alter the candle power in the immediate neighborhood of the works as compared with it at a distance. In other words, whether there would not be a tendency from having the vapors carried forward in the gas, and deposited after the gas had traveled a little distance, whether there would not be a difference in the illuminating power in the neighborhood of the works and in the outlying districts. Have they observed any difference in that respect?

MR. SHERMAN—I do not know whether any of the other gentlemen have had any experience in the use of injected naphtha; but I would say that when we started out with it we used rather a large quantity of it, using four barrels per day, where we are now using only one; and I ran against the objection you speak of—that of the gas smoking in the vicinity of the works. That was easily remedied, however, by reducing the amount of naphtha used.

MR. C. J. R. HUMPHREYS—We have had trouble from naphthaline in our city, and particularly in the month of September, and we tried a good many schemes, and last year we adopted the plan of injecting naphtha in the form of vapor at the outlet of the holder. I suppose I was probably too timid with regard to it. I was afraid that we would have trouble from smoking burners and injected very little oil—only about one-tenth of a gallon per thousand feet. We tried it again this season. I cannot say that it helped us any. I believe there is one other city in New England (I do not know whether any representative of that city is here) where they have tried the same plan; and they had a great many complaints with regard to blackening the ceilings from smoking burners, and they gave up the plan. I believe in that works they adopted the scheme of running some of their retorts at quite a low

temperature. I do not know how successful that will be. For my own part, not being willing to continue the oil, or to increase it to any extent for fear I would get into the same difficulty, I have gone back to the plan of injecting oil into the retort, which, taking it first and last seems to serve the purpose in our case as well as anything else.

MR. ROBERT YOUNG—Did Mr. Humphreys inject the oil in a liquid form, or vaporize it before putting it into the pipe?

MR. C. J. R. HUMPHREYS—We first tried the liquid, and then proceeded to vaporize it. We tried it during last year and started in again this season. But, as I have said, I got a little nervous as to the effect it was going to have on the burners, and hearing that it gave the same trouble in another New England city we abandoned that scheme altogether and began to inject oil into the retorts.

MR. SEARLE—It is almost conclusively proven that unfixed illuminants and naphtha vapor can be carried a long distance; but do not Mr Shadbolt and Mr. Mitchell both really enrich their gas with naphtha by bringing a vehicle back to point referred to in the paper and loading that with the naphtha previously contained in coal gas and so doing exactly what these other men have been doing with the injector and saving trouble and naphtha?

MR. MITCHELL—That is what he states in his patent.

MR. A. S. MILLER—I would like to ask Mr. Sherman whether he thinks that the naphtha vapor is carried to the burner, or whether he gets any naphtha in solution out of his drips.

MR. SHERMAN—When we were using a large quantity, as I said, four barrels of naphtha, we had a deposit in the drips in the immediate vicinity of the gas holder; but with the small quantity we use at present (one barrel) we do not notice it. I visited a works in Massachusetts, last fall, and they claim to be entirely relieved from naphthaline by merely passing a small quantity of their gas—what would pass through a 20-light meter—over naphtha of 72 gravity, without any heating; and they claimed that they were having no trouble with naphthaline. So that there are various ways of using it. In our case it seems the most reasonable way to vaporize it.

MR. GREENOUGH—It is almost impossible to listen to a discussion on the subject of naphthaline without wishing to take part in it oneself. The naphthaline trouble is, as I think, almost inseparable from the manufacture of coal gas during the Fall; but I think that the trouble comes largely from the impossibility of properly condensing the gas before it leaves the holder. So far as I am personally concerned, I may say that in our principal station we substantially see no naphthaline whatever about the works. As for those stoppages of which Mr. Mitchell complains, in the gas holder pipes, or in any other portion of the works, I will say that I never see them at all. The gas is enriched with naphtha continually by the production of naphtha and vaporizing it and making it into gas in the retorts. We see none of it. We see none of it in the outlet of holder; but in the services and in the consumers' meters in the month of September, we occasionally have a severe dose—not as severe as in the case that Mr. Sherman has spoken of, but at the same time it gives us considerable trouble and annoyance. As to putting vapor in at the outlet of your holder and running it all into the city, I must confess that it seems to me that it cannot be suggested seriously; for you would hear from your consumers with regard to the smokiness of the gas. Of course, Mr. Sherman has given testimony on the other side; but wherever we have introduced naphtha into the pipes in times past, as I understand it used to be done occasionally in Cleveland for the purpose of clearing out pipe stoppages, then there was always complaint from people in that vicinity as to the smokiness of their burners. Just as soon as we get cool weather, so that the condensation is made in the condenser, then the naphthaline stops right away. I believe that the remedy for naphthaline is most distinctly a proper and thorough condensation. I do not know anything in the world that will produce so fine a deposit of naphtha all through the gas works as by taking a multitubular water condenser and putting cool water on the gas as it leaves the retort house. If gentlemen wish to make a good article of naphthaline in baskets, they can produce it in that way. I think if Mr. Mitchell had an air, in place of the water condenser, or even if he had a hot scrubber before it, he would find himself very greatly assisted. So far as we are concerned, we got no substantial remedy until we began to cool our gas thoroughly. We all know how, in the early part of September, when the consumption jumps up and the weather stays hot at the

same time, we are sending out gas and putting it in the holder at a temperature where it is not properly condensed. I believe that we deposit the material in the holder, and that then the gas takes that material out of the holder itself and carries it into the town and deposits it there, and we cannot stop it, no matter what we do in the works. I think that thorough condensation is the remedy for naphthaline.

MR. H. H. WHITE—I started a few moments ago, when there was some discussion about the blackening of walls, to ask what effect this naphtha had on mantles. I would like to know the experience of gas engineers in the Association who are interested in the Welsbach mantle as to what effect naphtha introduced in the mains had on the life of the mantles which were not adjusted by the patented adjustable device which the Welsbach people have recently introduced. I have had no trouble with naphthaline that we could not get rid of, but I hear a great deal of it, and I would like to hear the experience of members about it.

THE PRESIDENT—Can anyone answer Mr. White's question?

MR. NEAL—Before the discussion closes I would like to relate a circumstance in relation to naphthaline. In the Somerville district a six-inch pipe was constantly stopped, and at last we had to cut it out in long lengths, and then run an iron brush through it to remove whatever there might be there. And what do you think we found? We found a stone that occupied perhaps half the diameter of the pipe and which was all covered with naphthaline. In addition to that we found part of an old umbrella. It looked as if it had been drawn through a snow bank. Whenever the naphthaline is moving along the pipe these obstructions detain it, and in that way make trouble. This pipe was laid thirty years ago. The only way we can account for finding this large stone there, and part of an umbrella, is this, that the boys, when the men went to their dinner, might have put those things in. When they were drawn out we had no more trouble from obstructions in that pipe.

THE PRESIDENT—Will Mr. Pratt take part in this discussion?

MR. E. G. PRATT—I have nothing to say, except that Mr. H. H. White has made an inquiry, and in answer to that I can say that the use of naphtha to the extent that it has been recommended here, would, I think, give a great deal of trouble; and especially

the use of naphtha to the extent of creating smoke, inasmuch as the conditions would change continuously, and it would be a great deal of trouble to keep his mantles or regulator adjusted in order to prevent the blackening of the mantle. While Mr. C. J. R. Humphreys was speaking I was reminded of a visit to the Providence gas works a few days ago, at which time Mr. Slater told me that he had used naphtha in the same manner in which Mr. Sherman has been using it, but had abandoned the use of it on account of the smoke and complaints made by consumers. Or, if the smoke was not objectionable, sometimes there was an odor, which can be readily detected, I think, when a person goes into a closed cool room where naphtha has been used. I think that Mr. Slater is now using one bench in which he runs two-hour charges, but has run it for so short a time that I was unable to get any facts with respect to its results.

MR. SEARLE—I would like to ask Mr. Greenough if he knows where the most trouble occurs in Cleveland—whether in the high or the low levels; and whether that has anything to do with it?

MR. GREENOUGH—We do not have many high or low levels in Cleveland; it is substantially flat there until you get some distance away. We get the trouble generally where a pipe goes through a cellar wall. It is almost invariably there.

MR. C. J. R. HUMPHREYS—We had one little experience which might bear on the matter of the influence of naphtha on the Welsbach mantles. We had trouble from naphthaline in one section of the city, and put vaporized naphtha into the two pipes leading to that section of the city, using a wagon which we fitted up to keep the naphtha hot. We had a great many Welsbach burners there. The result was that we had to go through the entire section and give every customer new mantles.

MR. JENKINS—After studying this matter considerably I concluded to take up a few of the services that were giving us the most trouble, and in every instance where we have taken out an old service and put in a new one, a larger one, we have not had a complaint since. In one of the services that we took up, I found a stop cock shut off three-fourths. The pipe was stopped and almost filled with rust, and we were having a complaint about every second day with respect to naphthaline on that line. We had a hospital which had a one-inch service pipe in a building

containing about fifty inmates, and we put in a two-inch pipe, and have not heard from there since.

MR. WATSON—I would like to say a word with regard to naphthaline in service pipes. About three years ago we commenced to cover our service pipes with terra cotta piping, putting a jacket of this pipe over every one of the service pipes, and since then have very seldom had any complaints as to naphthaline in the service pipes so covered. We carried the pipe through the cellar wall into the cellar. This seems to be a remedy.

MR. SHERMAN—Referring to this matter of blackening the mantles of Welsbach burners, I would like to ask Mr. Humphreys how much naphtha he introduced into the pipes where he had this trouble?

MR. C. J. R. HUMPHREYS—I cannot give you any statement as to that. The gas pipes there, were, of course, away from our works, and were all in one section of the city. We put into those two pipes together half a barrel of naphtha. One was a six-inch pipe, and the other was six or four inches.

MR. SHERMAN—I think that would account for the blackening of the mantles, if you put that in a six inch pipe without knowing the quantity of gas passing through it. While on the question of temperature I would like to say to Mr. Greenough that I made an experiment in that direction which was not a success. I took the ground that if we could reduce the temperature we could deposit the naphthaline in our own works, in our own yard. So we went to the expense of putting up a large multitubular condenser immediately outside of the purifying house. I brought the temperature of the gas from 74° , as it came from the purifiers, down to 64° . The temperature of the gas in our main, for 12 months, would average 60° . I thought we could bring the temperature down to somewhere near that of our street mains, we would have the deposit there where we could take care of it, and save our customers the annoyance of having it in their burners and fixtures. But it did not prove a success. The disturbance with naphthaline went on all the same after we had brought the temperature down to 64° by the use of the multitubular condenser.

MR. GREENOUGH—Did you get anything out of the condenser?

MR. SHERMAN—No; but I expected to remove it in large quantities. While it does not reduce the deposit of naphthaline, it reduces

the temperature, as I expected. I proportioned the size of the condenser according to the rules laid down in the books; but I think the gas passed through it at too great a velocity to do the work. I should say that the failure was there.

MR. R. YOUNG—Where was the average of 60° ascertained as you say?

MR. SHERMAN—In the ground.

MR. R. YOUNG—What are the extreme variations?

MR. SHERMAN—I have not got the figures here, but it was surprising to find how little variation of temperature there is between the summer and winter in the temperature of the gas in our mains. There is not above 20° difference between summer and winter.

MR. THOMPSON—It seems to me that this discussion has been devoted more to the naphthaline feature than to the one which was in the mind of Mr. Shadbolt in writing his paper on enrichment. I trust that Mr. Mitchell, or some one else who is able to conduct the experiments in coal gas works, where the coal and water gas are absolutely separated, will carry on the experiments during the coming year, and will give us results in the line on which Mr. Shadbolt worked, a year hence. I move a very hearty vote of thanks to Mr. Mitchell for his paper.

THE PRESIDENT—Before putting Mr. Thompson's vote we will give Mr. Mitchell an opportunity to reply to the discussion.

MR. MITCHELL—In reference to the condensing apparatus, I will say that I believe that we are all wrong about our condensing apparatus, and that we have a great deal to learn about condensing our gas. I think that as gas comes away from the retort it shows a candle power of about 25 or 26; but as it goes out of the station meter it has only about 16 or 17 candle power. Now, the point is that we should keep that gas as near as possible at the candle power that it has when it comes from the retort. I think that gas is robbed of its candle power in the condensers and in the scrubbers. As to the best condenser, or the best form for condensing gas, I will say that I do not know what is the best form, but I believe that as our gas condensers are constructed now with multi-tubular condensers, the tar surfaces will take out a great proportion of hydro-carbons, but if we could condense our gas without its being brought in contact with tar surfaces we would have a richer

gas. I think that is a line that we should work along—and keep the candle power of our gas up. I think we rob gas of its candle power by condensing and scrubbing apparatus.

The motion of Mr. Thompson of a vote of thanks to Mr. Mitchell for his paper was then put and carried.

On motion of Mr. A. S. Miller, seconded by Mr. A. C. Humphreys, the Chair appointed as the Committee for selecting the place for holding the next annual meeting, A. S. Miller, William McDonald, and E. H. Jenkins.

The Association then took a recess until 2:30 P. M.

AFTERNOON SESSION.

The Association met at 2.30 P. M.

The Secretary read the following invitations:

From the Chamber of Commerce, Mayor, Council of the city of Nashville, and Governor of Tennessee, to visit the Centennial International Exposition at Nashville.

From the Newport News Shipbuilding and Dry Dock Company to visit the shipyards at Newport News.

From the Washington Steamboat Company fixing a special rate to members wishing to return by way of Washington.

Also telegrams from Mr. Osius, Mr. Crisfield and Mr. A. B. Slater, Jr., expressing regret at inability to attend this meeting of the Association.

THE PRESIDENT—I think the Committee on Nomination of Officers are ready to report.

Mr. Greenough read the following,

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS.

President—J. B. CROCKETT, San Francisco, Cal.

First Vice-President—A. C. HUMPHREYS, New York, N. Y.

Second Vice-President—G. G. RAMSDELL, Philadelphia, Pa.

Third Vice-President—E. G. PRATT, Des Moines, Ia.

Secretary and Treasurer—ALFRED E. FORSTALL, Montclair, N. J.

MEMBERS OF COUNCIL—TERMS EXPIRE 1899.

I. C. BAXTER, Detroit, Mich.

ALTEN S. MILLER, New York, N. Y.

E. H. JENKINS, Covington, Ky.

C. F. PRICHARD, Lynn, Mass.

M. S. GREENOUGH, *Chairman of Committee.*

THE PRESIDENT—You have heard the report of your Committee. What is your pleasure?

MR. A. C. WOOD—I move that Mr Littlehales cast the ballot of the Association for the election of the gentlemen whose names have been presented by the Committee.

Seconded, put and carried.

MR. LITTLEHALES—I have the pleasure of reporting that the gentlemen whose names have been read are unanimously elected officers of the Association for the ensuing year.

THE PRESIDENT—You have heard the report of the gentleman appointed to cast the ballot. Those whose names have just been read I declare elected your officers for the coming year.

In the absence of Mr. Crockett, the President-elect, I will ask Mr. Greenough to speak for him.

MR. GREENOUGH—I will say for Mr. Crockett that he has not been able for the past year or two to be present at our meetings, owing to their distance from San Francisco, and to the fact that he has been obliged to go abroad. He had made all arrangements to attend this meeting, and expected to do so until the last minute, when he was unexpectedly prevented from starting. I think it would not be improper to read a letter which I received from him a short time ago, in which he says: "I consider the position a high and honorable one, and one which I will do my utmost to fill creditably. When you realize that it is a long way to go from here and that in the last two years I have been to Europe, looking after both gas and electric light matters, and upon my return home have made a combination between the gas and electric light companies here, and have had an immense amount of detail work thrown upon me, you will understand that my business has kept me very much occupied. These are my reasons for not having taken a more active part in the proceedings of the Association." And there is more to the same effect. I think we can look forward to seeing Mr. Crockett here next year and I am confident that he will appreciate very highly the compliment which has been paid him.

THE PRESIDENT—I am sure we shall all be glad to hear from Mr. A. C. Humphreys. Coming events cast their shadows before, and a year from now we shall all welcome him, I have no doubt, as the President of the Association.

MR. A. C. HUMPHREYS—I thank you for the honor you have conferred upon me. I consider it an honor. I can only say that I shall endeavor to do my duty—if there is any duty to perform in connection with the office of Vice-President. I thank you again.

THE PRESIDENT—I am glad to present to you Mr. Ramsdell, your Second Vice-President.

MR. RAMSDELL—Mr. Humphreys has expressed my sentiments exactly. I am very grateful for the honor which has been conferred, and like Mr. Humphreys I will try to do my full duty.

THE PRESIDENT—It is always a matter of interest to the Association to know who will be named for Third Vice-President. While our nominee is a representative of the West, yet we of New England still claim him as an Eastern man. We all want to hear from Mr. Pratt.

MR. PRATT—Like the gentlemen who have preceded me, I will rise and express my thanks to those who have kindly elected me to the office of Third Vice-President. I shall study closely the work of my predecessors, and if it shall become my good fortune to be made president at any time, I assure you I shall do my very best to follow in the footsteps of those who have best performed the duties of that office.

THE PRESIDENT—Last, but not least, is the Secretary, Mr. Forstall.

MR. FORSTALL—I have remarked before that the Secretary is usually chosen from the men who do little talking and much work. So I will say nothing and “saw wood.”

THE PRESIDENT—We will now listen to the paper of Mr. Paul Doty, entitled “Report on Burner Stoppages.”

(For paper see appendix page xx.)

THE PRESIDENT—This excellent paper is now before you for discussion, and I trust it will be interesting and instructive. Will Mr. Miller start the discussion?

MR. A. S. MILLER—I have read this paper with a great deal of interest, and especially since I have experienced some of the troubles to which Mr. Doty refers. I have had the burners stopped by using an iron sponge in which the iron was not completely oxidized. I have also had burner stoppages on the ends of new mains when I did not have them anywhere else—showing that

beyond all question the carbonic oxide must have taken up iron from the main and afterwards deposited it on the burner tips. I do not know that I can add anything to the subject which has been so very well covered.

Mr. Doty has put in a great many formulae, and has stated that certain reactions take place. I would like to know whether Mr. Doty knows that these reactions do take place. There is a combination of copperas and sal-ammoniac, making ferrous chloride, sulphate of ammonium and water. Is it the fact that when those two are mixed together those particular reactions will take place? Also, what is the advantage in mixing copperas and sal-ammoniac to make oxide of iron? If one wants to make oxide of iron, the best way would seem to be to oxidize the iron itself, or precipitate the hydrated oxide out of a solution of copperas.

I notice that Mr. Doty refers to blue and green vitriol. I do not quite see the connection. Blue vitriol, I believe, is copper sulphate. I understand that he is referring to iron sulphate. Another thing I could not quite understand, and would like to ask Mr. Doty about. On page xxviii, about the middle of the page, he says: "The material was at once removed from the purifiers. box after box, and saturated with commercial ammonia water, and frequently turned to expose all unoxidized iron to the oxygen of the atmosphere." Ammonia water is a powerful alkali, and I should not suppose that it would aid in oxidation. It might be found to do so in practice, and it would be interesting to know whether he did find it so to do.

MR. HAYWARD—I suppose it is natural to expect that I should respond somewhat to this paper. If you will turn to page xxvii, near the bottom, and read the reference to an experience which the writer had in the summer of 1896, where it speaks of buying 2500 bushels of commercial oxide; and then, if you will turn over the page you will find that he refers to it subsequently and always as "sponge." I suppose that everybody in this room knows that my enemies call me "Sponge Hayward," and my friends call me "Governor." Mr. Doty gave me fair warning that he was going to climb all over me at this meeting, and I think he has succeeded in doing it fairly well; but I ought perhaps to make some explanation with regard to it, and tell you how I have regarded Mr. Doty; and I think that all of you regard him in the same light—as a

graduate of the highest technical school in the land; as a graduate of the great U. G. I. Company, whose motto and ambition always is to secure the brightest, keenest and sharpest gas engineers they can get in all the land; and, not content with their own acquirements, they collect them together many times a year and pour into them rivers of knowledge and experience on every subject that pertains to purification, distribution and—acquisition. Regarding Mr. Doty in that light, and selling him material, in the words of Gen. Harbison, “modesty forbids” that I should venture to give him any advice in respect to using new material, because one of the first rules laid down by the company that he left, was, not to use new oxide alone, but have in the last box old oxide. That has been given to me repeatedly; but he has given the key to this whole matter when he finally adopted the use of clay as a filter to prevent the burner stoppage. Whatever the burner stoppage may be, it will, of course, always be a prolific subject for discussion; and you know that when doctors of medicine get together, and want to have a little argument, they bring up the old subject, “What is scrofula?” and the gas men in the same way, and for the same reason, have only to say “Naphthaline.” Now, it would seem we have struck a new and prolific source of enquiry. If we want to get into an active discussion at any time, we have only to ask the question, “Burner stoppage? What is it? And what is the material?” I have made a few notes on the subject, because I cannot very well carry in my mind the technical part of his paper that I want to refer to, and with your permission I will read them.

Dr. Love writes in the “Journal of the Society for Chemical Industry,” 1893, that they are composed entirely of carbon and contain no iron. Dr. Woodman reports 0.79% of iron oxide or 0.553% of iron. As iron is one of the easiest metals to determine, it seems that Dr. Love would have found it, if it had been present in his specimen. Either of these analyses alone might have been sufficient to satisfy the gas manager, but with both of them, both from perfectly reliable chemists, giving results diametrically opposite, the question arises whether we are any further towards the real solution of the difficulty. It seems as though the incrustation may form and under different causes does form, certainly with marked difference of composition. Dr. Love's sample might have been caused or not by iron carbonyl. Did the iron pass away without leaving a trace? The iron occurs in such small proportions in

comparison with the carbon, 55 to 9689 or 1 to 176, that Dr. Woodman's remark that there is some other cause, may be well made. If Dr. Love had not specially mentioned iron, we might have inferred its possible presence, but he directly states that it was not there.

No analysis is given to show that the mixture mentioned on page xxv did not contain small quantities of free iron, the presence of which was very probable.

In the operation of making oxidized copperas or ferric sulphate the item of cost of methods employed plays quite a part. $6(\text{FeSO}_4, 7\text{H}_2\text{O}) + 3\text{H}_2\text{SO}_4 + \text{KClO}_3$ or 1668 parts copperas, 294 sulphuric acid and 122 chlorate of potash, produce 1200 of ferric sulphate. (These figures are taken from the paper.)

This has cost, and I am giving you now the commercial value of the materials as we buy them in the market:

1668 of copperas at $\frac{3}{4}\text{c}$	cost, \$12.51
294 oil of vitriol, at 1c.....	" 2.94
122 chlorate of potash, at 10c.....	" 12.20
1200 ferric sulphate.....	" 27.65
Or one pound.....	" .023
Equal to \$46.00 per ton;	

and the iron oxide produced from it would cost $400/214 \times \$46.00$ equals \$86.00 per ton, not counting the cost of the ammonia. This will be mixed with an equal weight of sawdust, making the cost per ton \$43.00, and as there are about forty bushels to the ton of mixture the bushel would cost a little over \$1.07. Can you afford to pay this amount? Well, Long Branch, as you know, has lots of money and, perhaps, can afford to pay \$1 07 for a bushel of oxide; but I would have to go out of the business if I had to sell it for that.

In recounting the experience with the sponge in 1896 the key note is struck in stating that it is believed the use of clay was of good effect in preventing further stoppages. Any other material composed of fine particles would have done as well; a layer of old sponge is commonly used, a layer of asbestos, of ashes, or any like material would have acted as a retainer of the carbonyl if present. The action of the clay may be explained by remembering that iron carbonyl, as described, is a viscous liquid, and would be readily retained by any fine porous material through which it passed. Clay,

carbon, chalk and other porous materials have the property of collecting and retaining within their pores a great variety of substances, even where no trace of chemical action can be discovered, and while only mechanical action can be assumed as the cause. Clay, as is well known, will remove the final trace of color from sugar after charcoal has practically ceased to work. Had a layer of clay been used with the sponge originally I believe no trouble would have occurred.

Iron carbonyl is decomposed at 180°C . or 356°F . into carbonic oxide and iron. In case the temperature of the burner tip reaches 356° , which it undoubtedly does, the iron would be deposited and the carbon pass on into the flame. In time the iron would be oxidized, but probably not in presence of carbon and reducing gases until it became cold. What do we find in the deposit? Dr. Love says, all carbon and no iron. Dr. Woodman says, carbon and iron in the proportion of 176 to 1, yet the action of the heat on the carbonyl is to cause the iron to be deposited and the carbon to pass on as carbonic oxide. The presence of a large per cent of carbon is not then explained. Does the presence of iron carbonyl explain the sulphuric acid or the silica found by Dr. Woodman. He found nearly as much silica as he did metallic iron, 0.55% iron and 0.51% of silica. Does not the general law of solution among substances have some application here? Does not the fact that all substances are soluble in all other substances to a minute degree obtain here? How else can we explain the presence of as much silica as iron? How did it get there? If it was generated in the gas at its formation and passed through all the scrubbers, condensers and purifiers, it certainly must have been intimately combined with some portion of the gas, and not merely mixed with it mechanically. The question is not by any means settled, but every communication helps.

Nothing is on record showing the amount of silica or sulphuric acid deposited on the burner tip before using a filter like clay or old sponge, and after using the same. With iron carbonyl the paper shows that this filtering process is effectual. Why not use it then always?

I want to add one more word to this, and that is as to a point to which Mr. Doty did not refer, and that was that he had just laid 14 or 15 miles of new pipe and of new work, and as he was starting in, there was all that exposure of new iron; and he must have

known there was great danger (from the paper he has read), by the carbonic oxide coming in contact with all that new iron.

MR. A. C. HUMPHREYS—I was not proposing to take part in this discussion, but “Governor” Hayward has brought me to my feet. The general investigation referred to occurred under my direction, and I have never ceased to be proud of that investigation. I think we learned a great deal not only about burner stoppages, but also about how to conduct the gas business and how to conduct such an Association as this—namely, by taking up one subject and following it through to the end, and not merely going at it piecemeal, but year after year to consistently follow the subject, changing the methods to be pursued according to the developments made by the discussions of the previous years. For instance, the men selected for work were selected according to the particular points to be developed in the next discussion. Mr. Nute and Mr. Harper, who are with us to-day, were some of those selected to take part in this special investigation; and while we at first obtained results apparently most conflicting and contradictory, these would finally be explained and tied together; and there is not the slightest question but that in this particular case we ultimately arrived at the result that if the gas were not exposed to clean surfaces of iron, we did not experience the trouble. There is not the slightest doubt in my mind that we correctly arrived at this conclusion, and were able to conduct our business on that conclusion, namely, that it was possible to prepare an oxide that could be at once put into use without any screening material. It was a very remarkable fact that a number of men sat through the various discussions of this problem without being able to appreciate why we made so much of the subject, for they had had no such trouble; but when we came to investigate their cases it was found that the reason for the lack of trouble was because they prepared their oxides in ways which gave perfect oxidation. Now, for my part, I am willing to take the full responsibility for having first instructed the men to use the old oxide as a screen, and gradually bring the new oxide into use. It remained for a strictly practical man, Mr. Chandler, of Harrisburg (it was he who first used the term “Christmas trees” in connection with this form of stoppage), to show us that we “scientific” men, as he called us, were wrong in believing that the partial use of the old oxide in connection with the new would prevent the trouble. It was only when we arrived at

the conclusion that we must have a complete oxidization of all the iron that we completely got rid of our trouble. Unquestionably Mr. Hayward has struck a valuable point, or referred to it, as both other speakers have, namely, that we are going to get trouble from any *clean* iron. We know that we have had trouble simply from the exposure of a new set of mains, and that when those mains were coated the trouble stopped, irrespective of the oxide used. Of course it makes no difference where gas finds the iron; it will give the same results, whether it be in the purifiers or in the pipes.

MR. BREDEL—I would ask Mr. Humphreys if he has paid any attention to the question of whether his service pipes were of wrought iron or of steel. I think that would make an enormous difference.

MR. A. C. HUMPHREYS—My recollection is that the question did come up, but I do not carry in mind what the difference, if any, was.

MR. BREDEL—It may be that while using wrought iron pipes you would not have the trouble, but would have it when using steel pipes.

MR. A. C. HUMPHREYS—I would say that of course in my previous remarks I was referring to cast iron main pipes.

MR. WHEELER—I was very much interested in Mr. Hayward's remarks, and there are two or three things that I would like to say something about. After we had had all this trouble, and had made a great many trials to overcome the difficulty, and had had a great many tribulations, it was suggested that as we had a pile of the original sponge in the corner of the cellar which had never been used, we might, for the purpose of comparison with the results that Mr. Tuttle arrived at, as given in Mr. Doty's paper, pass some of our gas through that sponge which had never previously been used, and see how much carbonyl of iron would be deposited, and then perform the same experiment with sponge in use, which was not giving any trouble whatever. Mr. Doty's paper, I think, gives about 500 milligrammes, for he says (page xxxv), "Results of two quantitative analyses show 500 milligrammes and 485 milligrammes or 7.5 grains per 1000 cubic feet gas." At that time we were having no trouble at all in Long Branch. We did have a little trouble at the end of this long new line of pipe. We found that we had 900 milligrammes of iron thrown down in the new sponge

which had never been used, but which had laid in the cellar exposed to dampness and to the effect of escaping steam for several months. I think that is an interesting point showing how much carbonyl of iron the gas will carry, how much it will pick up as between iron which is not completely oxidized, and iron which is sufficiently oxidized to perform the work very well in the purifying box. I will also state that we did have one box of old oxide on at the time. We put that in at the very start; but it was not sufficient to do what we expected it would do. Another point I should mention, and that is the fact that all the burner stoppages which we had in Long Branch were not on this 15 miles of new pipe which Mr. Hayward speaks of. There was not a cubic foot of gas used in Long Branch from that new main at the time of this trouble; it was all from old mains which had been in use for a long time.

DR. BIRCHMORE—In the interest of common justice I should state that Mr. Hayward has said that this material in question, carbonyl of iron, is a viscous fluid which would be picked up on the asbestos filter. At 20° below zero C. this is strictly true; but Mr. Hayward has misread Mr. Doty's quotation, and has misunderstood what Mr. Doty sought to say. I have taken considerable trouble to go all through this thing myself, and I have made these experiments which have been suggested, with glass tubes for mains. In order to be sure that I was entirely free from the charge of using anything else in hand I took a carbon monoxide which was perfectly pure, or rather as nearly pure as it can be made in the laboratory; and I then passed that carbon monoxide over some iron which had been carefully thrown down by hydrogen, so that I had as nearly pure mineral iron as it was possible for one to get. I tried hard to see whether the assertion (which I believed would be the fact) that I could clog the burners with it by passing it through a narrow slot in the tube, would hold; and it would not. The iron deposited on the inside of the tip and the carbon-monoxide went through. I then took some vapor of a "petroleum ether" which I had in a carburettor, which I had prepared for some quantitative experiments, and passed the vapor of the petroleum ether and iron carbonyl mixed together through a burner slot, and clogged it in less than two minutes,—thus making the thing perfectly manifest that the third thing which we have to have is that action between the two series of molecules which Mr. Doty spoke of to me yesterday on the steamer, when he asked

me if I did not think that there was a changing back and forth between the two. I meant to have told him then, but thought I would keep it for here, that if we pass the carbon monoxide carrying iron, it carries it exactly the same as it would if we had a benzene ring in which we had broken out a portion of the molecule and put iron in its place, and substituted oxygen for all hydrogen members, through a tube, when it comes into air which is hot, it breaks down again in just the same way that the benzene ring breaks down; and if iron is there, it does leave it behind on the inside of the tube; but if you pass with it a hydro-carbon in vapor, it leaves it on top, or makes a quantity of what is called lamp black. It is not pure carbon, it is lamp black, which is left with the iron. If working under conditions of control counts for anything, then Mr. Doty's burner stoppage is that burner stoppage. In using compressed street gas at very high pressures I have succeeded in producing this same thing (the mirror) on the surface of Drummond light candles (the lime light) and thrown the iron directly down so as to convert it into Prussian blue on the face of it; although I thought that there was no carbonyl of iron in the gas when it was put into the iron can, the carbonyl of iron was found. All of it was taken up by the carbon monoxide after it was put into the can. It had stayed there for 28 days, it is true, but there was none there when it was put in. When it came out, it left the iron stain on the lime light candle. I think that should be a sufficient demonstration that the stain does come. Furthermore, although you cannot clog the fine hole through a platinum tip by means of the carbonyl of iron alone, you can do it with sulphuric ether as well as I did with petroleum. That has been proven experimentally.

MR. MATHER—I would like to ask Mr. Doty if he has made an analysis of the clay which he used to pass the gas through?

MR. A. E. FORSTALL—I happen to have had an experience with burner stoppages in which all the conflicting points were eliminated, so that we were absolutely certain that the trouble came from the use of fresh oxide of iron; and it may perhaps be worth while for me to relate it. About five years ago we started an entirely new batch of oxide of iron, and in about three days fully one-fourth of our street lamps were in bad shape. We had not laid any new pipe; it was before the days when steel pipe had

been used to any extent in Newark; all our services were of wrought iron, and we could not place the trouble at all until we heard incidentally from the United Gas Improvement Company that they had been having the same trouble with oxide of iron. We took the precaution which they recommended, and the trouble stopped at once. There is a case where apparently, as far as anyone could see, the trouble was entirely due to the new oxide of iron. Since then we have been very careful never to use any entirely new oxide of iron without putting a layer of old oxide on top of it, and we have had no trouble. Of course, it is a nuisance to have to put two layers of oxide of iron into a box where otherwise you would put in only one, for you have to use a double set of trays; and they all have to be cleaned each time the box is changed, and the labor is probably 50 per cent. more in handling the oxide in two layers than in handling the same amount in one layer. If oxide can be gotten which can be used straight, and without any catch layer, it is a great deal better to have it.

MR. LITTLEHALES—It seems to me that everyone who has experienced this difficulty has been using a manufactured oxide. I have been using for many years a natural oxide, and never saw the faintest trace of the difficulty which has been referred to in any shape or form, even when turning the gas into four boxes filled with new material. I think, if that fact is proven, that it comes from the small particles of metallic iron remaining in the oxide. With natural oxide, which we take out of the ground, I do not believe that it will ever occur. I have never seen it, and never have heard of it; and from the experiences which have been related here the trouble seems to be invariably with the manufactured oxide. Where there are different degrees of coarseness of the filings out of which it is made, some particles take longer to oxidize than others, and there are small particles of metallic iron in it. That covers the supply of coal and water gas together, and covers also the supplying through new mains. I have never seen any of this trouble.

MR. A. C. HUMPHREYS—I would suggest one thought more in connection with what Mr. Forstall has said—that there still seems to exist some efficacy in using old material as a screen. I was led to believe, after going through this work, that the benefit of that course was to be found in the reduction in the amount of metallic

iron as exposed by the new oxide; and when we finally reduced the amount of the new oxide down to a sufficiently low amount the excess of trouble ceased. The trouble was there, but it was not of sufficient importance to bother us. It was not that we screened out the trouble, but simply that we were able to stand the ill effects of that much of new material. Another very striking point that we reached was this: one of our superintendents made an independent investigation by making his oxide in a way which secured perfect oxidation, though at too high a cost to be employed commercially. He pulverized the iron, and so manipulated it as to be sure that he had every particle oxidized, and made up one lot in this way. It did not give the slightest trouble. He put it all in use at once. This would seem to confirm Mr. Littlehales' suggestion as to the advantage of using natural oxide, and thus avoiding the presence of any metallic iron.

MR. A. S. MILLER—I would ask Mr. Bredel why steel pipes will cause more trouble than wrought iron?

MR. BREDEL—When steel is hardened by immersing in water or by the other hardening process of cold rolling or drawing, iron carbonyl is formed. Speaking of burner stoppages I may say that I had the same experience in Madison, where there was a great deal of trouble from that cause. I looked over the oxide purifying material supplied by Mr. Hayward and found that the trouble was not due to the oxide, but that part of the purifiers were used as scrubbers. So I put in a washer, and the trouble disappeared. This formation does not go on with wrought iron. Is it not, therefore, possible that by using wrought iron pipe instead of steel the trouble would be obviated?

THE PRESIDENT—If there are no further remarks on this paper, Mr. Doty will now close the discussion.

MR. DOTY—Replying to Mr. Miller's questions, copperas was used with sal-ammoniac in following instructions given in a formula for the preparation of oxide. The method was tried and found wanting. Ferrous sulphate is, of course, green vitriol. It is so understood by the speaker in the paper. Referring to the use of ammonia water with metallic iron, I may say it is well known that iron rust is alkaline, and in that condition it will best remove sulphuretted hydrogen.

Referring to Mr. Mather's question, I would say that I have not the analysis of the clay in use. The material was obtained locally in the work's yard.

"Governor" Hayward has chosen to throw down the gauntlet in the matter of costs and materials. He has also chosen to fit the cap to his head in the matter of the use of the sponge in question. I purposely refrained from giving any costs or proportions. I made no reference to where the sponge came from. It is not my business to manufacture oxide of iron in competition with gentlemen who are in that business. I will say for myself, however, that the copperas oxide did not cost \$1.07 per bushel, because we did not use the quantities he assumes we did. We did use one pound of copperas oxide per bushel of shavings, and the additional cost of that one pound was perhaps two or three cents. The copperas oxide was simply used to coat the shavings, and added to the iron oxide made from metallic iron. The copperas oxide helped the surface oxidation of the metallic iron. The best results in purification are obtained when the metallic iron is completely oxidized on the surface. The interior of the particles of iron borings may still be metallic iron. After a time these little particles of iron become globular in shape, and become worn by attrition. You can break the globules open and find inside the black iron still, although on the outside you have perfect oxidation. This globular condition of the oxide of iron is analagous to the globular condition of oxide of lime, the use of the latter in that condition being due to the honored father of our Secretary, Mr. Forstall. To the United Gas Improvement Co. under Mr. Humphrey's direction is due the credit of threshing out the truths of the questions of burner stoppages, and I make my acknowledgements of indebtedness to Mr. Humphreys.

On motion of Mr. Forstall, the thanks of the Association were voted to Mr. Doty for his paper.

THE PRESIDENT.—The next paper read will be that of Mr. F. H. Shelton, entitled "A Quadruplex Purifying Box; Why Not?"

(For paper see appendix page i.)

THE PRESIDENT.—We have heard a most interesting paper, and I think some of us are almost persuaded. It is now open for discussion. Will Mr. Littlehales speak on this subject?

MR. LITTLEHALES—We are all indebted to Mr. Shelton for much excellent and very valuable work done in this Association, but I think the paper he has just submitted is a clear evidence of a good man gone wrong. Before proceeding I would like to ask the question whether any set of boxes has yet been constructed on this plan?

MR. SHELTON—No.

MR. LITTLEHALES—Though I am not a prophet, nor the son of a prophet, I prophesy that there never will be. I cannot understand how anyone could rationally depart from our present system, with its advantages, for one that, when you boil it down, has but one solitary thing to recommend it, according to Mr. Shelton's own story, and that is economy of ground space. That is all that it comes down to. I must say that I am surprised to hear a gentleman of Mr. Shelton's experience taking the position he does as to the simplicity of handling it. I would have thought that such a plan came from a man who had never been inside of a gas works. I would, honestly. We all know how often we have had to send a man with a pick to loosen the oxide. Where would his collapsible grids be in such an emergency as that. What would he do with the oxide when it caked? All his wind mill fans would not break it. The oxide will, under certain conditions, get hard, and need a pick to loosen it, just as the lime does, and where will your collapsible grids come in then? Furthermore, the mere fact that one form of apparatus has been in use these many years does not lessen its value. The trouble is that some of us fail to see the true value of a system which has lasted for many years. Take the slide valve of the steam engine for example. It is practically the same to-day as it was fifty years ago. That is no detriment to the slide valve, nor any reason for rejecting it. In fact the whole argument of this paper can be answered by one single line from the paper (the 22nd line), where it says that "purifiers as constructed are undoubtedly simple and effective." Now, the first object in any apparatus is effectiveness. We all seek to gain that effectiveness in the simplest form. Is there anything more simple than the present form of purifying box? If we can ever reach the point where we can purify by liquids, then I think we may change the form of our purifying boxes to advantage. But while we purify with a dry material, I think the present form of box is as near perfection as it is possible to get it. And the cost of construction of the quadru-

plex box, I will venture to say, for equal purifying capacity (as far as I can judge from going carefully over this paper), will be double that of the present system. It is going to be difficult to let the purifying material down, and we must remember that the strength of any chain is its weakest link. Now, if it will only work satisfactorily while the purifying material is in a loose condition, how will it be sometime when you get the thing stuck? How shall we answer our consumers if we foul the gas with sulphuretted hydrogen, and send it out unpurified, as would result in such a case as that? Then, to use an Irish expression, when you change one purifier you change four. Instead of changing one, and being done with it, you have got to change the whole four. That seems to be multiplying the difficulty, and multiplying the handling at least three times more than is necessary. Taking it altogether, I cannot agree with Mr. Shelton for a single moment, in his statement that this is an improved plan. I take the paper as an evidence of a good man gone wrong, as I said before, and I think that the present purifying system will hold good when some of us have ceased making gas.

MR. BREDEL—The paper before us refers to the purifying plant at the Universal Gas Company's Works in Chicago, and it states that in the quadruplex system a great saving in floor space, building, etc., could have been made. Is this so? Let us see.

In considering the efficiency of any purifying system, the square area of the purifying box determines how much gas it will purify in 24 hours. The number of the boxes, or the thickness of the layers determine the rapidity with which a change of material, or revivifying, becomes necessary. In other words, the rate at which gas passes through purifying material will determine if this material is able or not to take up all the sulphuretted hydrogen. Never mind if one, or four boxes are in operation, provided at all times that the boxes are in sequence and not tandem. Actual experience has given the following results: A purifying material containing 30 per cent. and over of sulphur will purify gas completely of sulphuretted hydrogen when the speed is about 5 millimeters or a little less than $\frac{1}{4}$ inch; while new material will retain all the sulphuretted hydrogen if the speed is not more than 15 millimeters, or about $\frac{5}{8}$ inch. The speed is figured in considering the boxes empty. These experiments were made by Dr. Kunath, and also independently by me some years ago.

As we all want to use up the purifying material as much as possible, we should make our purifying boxes in such a way that the speed of the gas will not be over $\frac{24}{100}$ inch for gas works of two million feet capacity per day, and not over $\frac{20}{100}$ inch per gas works of less than two million feet capacity per day. For one million cubic feet daily production this will give an area of 575 square feet purifying surface for large gas works, and 630 square feet for small gas works.

The purifying boxes of the Universal Gas Works are put up in four series of two boxes each, and not in two series of four boxes each, dividing the gas stream in four parts, so that each set has to take care of two and a half million cubic feet. The boxes being 36 x 36 feet, each box has a square area of 1296 feet, which gives 576 square feet for every million feet capacity. The boxes should be generally worked so that the gas has to pass through ten feet of material, each box having a layer of five feet material. When revivifying, one box of one set should be cut off and the gas temporarily passed through one box only. Changes should be made when the first box shows foul. The revivification will then last about ten hours.

Mr. Shelton's quadruplex box is 20' x 65', or a square area of 1300 feet. The same is divided up in three parts, and when revivification becomes necessary, one part must be cut off; and during that time only $\frac{2}{3}$ of the box, or $\frac{2}{3}$ of 1300 equals 866 $\frac{2}{3}$ square feet of purifying surface, is available.

Putting the purifying box at the same rate as the one at the Universal Gas Works, the box would therefore have a capacity of 866 $\frac{2}{3}$ divided by 576. equals 1,504,000 cubic feet, or, say, 1 $\frac{1}{2}$ million feet, and the two boxes he proposes would therefore have a capacity of three million cubic feet. Therefore it would require at least six boxes like those Mr. Shelton proposes, and not two. The building, therefore, should be about three times as large, or have about 18,000 square feet of ground surface, while the area of the Universal Gas Works Building is only 16,000 square feet. So, instead of saving in floor space, it does exactly the reverse.

There would be a saving with the quadruplex, if the boxes at the Universal were arranged in two series of four boxes each, but their capacity would then be only five million feet instead of ten million. But the four-box system for oxide purification has seen its last days. It is entirely different with lime purification, where an entirely different reaction comes into play. Formerly purifying boxes were

made three feet deep, and the material was laid in each box in two or three layers. To-day the standard box is from five to six feet deep, and the material is laid in one layer from four to five feet deep, and one box with the five feet layer of material will purify as much gas before revivification becomes necessary as two boxes formerly did with each only $2\frac{1}{2}$ feet material.

To sum up once more, the square area of the smallest purifying box in any system, whether two or four boxes are employed consecutively, determines the capacity of how much gas can be purified in the time unit of 24 hours, providing at all times that the flow of gas is about even. The thickness of the layer, or the number of boxes, which would be the same, determines the time before revivification becomes necessary and has nothing whatever to do with the 24 hours rating of the box.

MR. A. S. MILLER—I think that Mr. Littlehales has said that this paper was an indication of a good man gone wrong. I think, likely Mr. Littlehales has forgotten that the science of astronomy grew out of astrology, and that the science of chemistry grew out of alchemy. I do not quite feel that Mr. Shelton has perfected a system, nevertheless I do feel that he has given us some ideas, and time alone can tell whether they will or will not be useful. No man can start out with an entirely new piece of machinery that somebody else, no matter how small his experience may be, cannot find fault with, and so I suppose we will have to proceed to find fault with Mr. Shelton's machinery; and, no doubt, incidentally Mr. Shelton may get an idea or two that will be useful to him, and will help him to make the machinery better.

At the top of the third page, Mr. Shelton remarks "that oxide, after use, unlike lime, is not caked, but will run, and can be handled entirely by gravity." Evidently Mr. Shelton has never dug the oxide from a box with a pick and shovel, as many of us have done. Of course, the oxide in the quadruplex box would be changed three times during the time that oxide in the ordinary box is changed once; nevertheless I believe that between the changes the oxide would at times get into a condition in which it would not run. I also think it would be a very serious disadvantage to have gear wheels or chain gearing, or any kind of machinery inside the box. No matter how well it were protected, even if there were a stuffing box, the fact that the grids would lie still for a long time would allow the packing to harden, and cause a leak. The foul gas would

leak in and around this machinery (whatever form it might be) and cause it to corrode rapidly. If all the machinery were outside, there would still be this stuffing box, and every time that the grids were turned, he would have to pack his stuffing box. That is, of course, purely theoretical, or purely the result of experience with other classes of machinery.

I feel that we have been rebuked for slovenly methods in not putting something to scrub the tar from the gas before it goes into the purifying box. If, in connection with the box, Mr. Shelton would get up a scrubber that would separate all the tar from the gas, I would love him a great deal more than I would on account of his purifying box, for I have a great deal more trouble in that direction than I have in purifying the gas.

Incidentally, and in connection with the remark of Mr. Shelton about revivifying the oxide in *situ*, I may say that of course it would be necessary to throw out one-half of his purifying system while he was revivifying in *situ*. As now arranged, we can throw out a single box and force air through it for a day or for a week, as the case may be, without in any way interfering with our general purifying system. But in Mr. Shelton's case he would have to abandon just one-half of the purifying capacity while he was revivifying in *situ*.

Mr. Littlehales made a remark, to which, although we are not a society of mechanical engineers, I would like to refer. He stated that the slide valve of the steam engine had not improved in fifty years. I would advise him to study slide valves.

MR. LITTLEHALES—I think Mr. Miller somewhat misunderstood my point. I said that the slide valve substantially as constructed fifty years ago, is the slide valve of to-day, and I repeat that statement.

MR. MILLER—And, Mr. President, I repeat my remarks.

MR. MATHER—I would ask Mr. Littlehales if his experience in purifying with oxide was not with the natural oxide which he has mentioned; and if his experience in the hardening of the oxide in the boxes, so that he would have to pick it out, was not obtained from the use of the natural oxide?

MR. LITTLEHALES—The case I referred to, where I have seen the oxide picked out, was a case of manufactured oxide. It was not in my own personal experience, but it is what I have seen in other places.

MR. MATHER—I would like to remark in that connection that so far as I have had observation of gas works, the hardening of oxide occurs usually on top of the layer. By Mr. Shelton's plan, the oxide beneath could be dropped out, leaving a space of six inches, and then the oxide above would have to come down. If there were any hard lumps in it, dropping it from tray to tray as he has proposed, and as he has fixed his T-irons would break up those lumps; and I do not think that the screen at the bottom would be necessary at all.

MR. BREDEL—Purifying boxes of a similar principle as the quadruplex; that is, self-emptying gravity system, were patented years ago by Mr. August Kloenne, and they have been actually executed and operated in Europe, but I am sorry to say they have also been abandoned, for the simple reason that the purifying material got so foolish; it had the bad custom, that all purifying material will develop, of caking, and then it was a nice job to handle it and empty the box. I guess we all know enough about caking material to imagine what that means. The purifying material used at that time was a natural oxide of iron.

MR. SOMERVILLE—I have no doubt that Mr. Shelton anticipated this criticism, and just on the very lines on which we are making it. The day after I read his very interesting paper it happened as I went into the purifying house the men were digging the oxide out in great lumps. I just stood and tried to contemplate the situation, and what would be the result of such caking in the quadruplex boxes of Mr. Shelton. I cannot understand how it is possible that these lumps could fall down in the way proposed. I do not, however, agree with Mr. Littlehales in saying that Mr. Shelton has gone wrong. I think he has gone right. I think it is a great thing to come forward here with a thing like that and invite our criticism upon it. That is the way we learn. I remember that some years ago (if you will pardon me) I stood here in the Association with great boldness and said that it was of no use trying to fire retorts with tar, that I had tried it and failed, and that the thing was a perfect humbug. Shortly after that, however, I became convinced that it was possible to fire retorts with tar. There were a great many letters came to the Journal saying that this man Somerville did not know what he was talking about, and the letters were right. Yet I did not see why a man should not talk about it anyway. The

story went over to England, I remember, and they kept the thing up until all of us knew thoroughly well how retorts could be fired with tar. My brother, John, many years ago, when he was engineer of the Dublin Gas Works, converted a 50-foot holder into an oxide purifier. He just used the cover, built a water seal, and it worked splendidly for a while, but the trouble was with this caking. It would cake, and it did cake. I believe it was abandoned on that account. I am afraid also that these clutches, and eye-beams, and ties, and other things in Mr. Shelton's plan will become useless so soon as the oxidation takes place, for you know how it affects wrought iron; and I doubt if, after it has been worked a little while, they will come back into their places again, for there is no means of getting out the small stuff that will corrode into these parts.

MR. THOMPSON—I cannot agree with Mr. Miller that the stuffing boxes would require packing after every time of using. We do not have to pack the stuffing boxes in our valves at the works every time they are used, even after they have been closed for some time. There is but one point in connection with the scheme under consideration to which I wish to refer, in addition to those brought out by previous speakers, and that is whether in dumping from tray to tray the oxide will come close enough to the sides of the box so that there will be no passage for the gas to go from tray to tray without being purified by coming in contact with the oxide—particularly where the rods carrying the fixed end of the tray are against the side of the box. In such an instance the tendency, of course, would be to pour outward, and not until the tray was exactly vertical up and down at the full length of its half-revolution would the oxide remain, and then it might not come in contact. When we fill the ordinary box it is customary to tamp the oxide against the sides, but of course nothing of that sort would be possible in this instance.

THE PRESIDENT—Is there any further discussion on this paper? If not Mr. Shelton will close it.

MR. SHELTON—I am very glad to think that there is no need for this improvement. Apparently you are all satisfied to continue as you are doing, without finding some good points in what I have proposed and sincerely advocated. I think, however, if what has

been said shall be digested you will see that there is not a great deal of stricture after all upon what has been outlined by me.

Mr. Littlehales has utterly failed to grasp the scheme of that paper. Mr. Littlehales' argument, when boiled down is this: The box as now built has always been good enough for us, and it will continue to be good enough for us. But, how far would we get ahead if we did not sometimes take a contrary line. With all due respect for what he has said it appears to me that Mr. Littlehales has far from shown any concrete, definite, tangible reasons *why* the quadruplex box will not work.

Mr. Littlehales would probably not say, if he had read the paper more carefully, that when we have to shift the oxide, we practically have to lay off all four boxes, or beds of oxide.

MR. LITTLEHALES—Not lay them off, but change them.

MR. SHELTON—If you will read the paper carefully, you will see that only a part of the box is at any time out of circuit.

By Mr. Littlehales' criticisms possibly I am learning the limitations of the box; at any rate that may lead to getting something better. Even if I fail utterly, I am sure he is fair enough to give me credit for striving in that direction.

As far as Mr. Bredel goes, I may say that his figures are utterly incomprehensible to me. I do not think that he gave sufficient study to the figures which I gave, or the scope of the device, or to the scheme that I have outlined, in his comparison with the plant in the Universal Works. How he figures out that with a quadruplex plant it would be necessary, in order to do the work of the Universal Gas Plant, that the building be two or three times as large, is beyond my comprehension. Please bear in mind, in considering his point, that what I have suggested is simply the stacking of existing boxes, one above the other, instead of running them along in a string, or in a square, as is the ordinary practice. We have still in effect the same boxes, the same area and cubic capacity of the oxide; we simply arrange them in a different way, by stacking one above the other. The gas still passes progressively through these different boxes. How, then, can it be necessary to have two or three times as many boxes to do the same work, as in existing plants?

Mr. Bredel has unconsciously—possibly consciously—borne in mind what is known as the "Bredel" method of connecting boxes,

which scheme is based upon the idea, as I understand it, of decreasing the rate, or speed, or flow, of the gas through boxes, by dividing it into four parts or streams, as compared with the ordinary single current of gas. That is done at the Universal Works by connecting the eight boxes in pairs by certain arrangements of pipe connections and valves. He is comparing practically his scheme of thus passing gas through boxes, with what I have proposed. But I am not comparing the difference in results between purifying in the quadruplex box and purifying in subdivided streams or in boxes connected in pairs, or, as relates to the speed of the passing gas. I am not comparing the quadruplex boxes with the "Bredel" arrangement of boxes, but simply proposing the quadruplex *box* (operating at the present speed and with the present masses of oxide), as against the present form of mechanical containing structures for oxide.

Mr. Miller has said that the oxide would cake to a considerable extent, that you would have to get in with a pick and shovel it out. I am very sorry if that is the condition of the East River works! I do not think, however, from quite an extensive investigation of the subject that the caking of oxide is nowadays such a trouble as would prohibit the use of this box. Oxide, as first used, did often cake, but that condition is steadily decreasing as better knowledge is gained of how to handle oxide and what conditions are to be avoided.

I think Mr. Hayward, Mr. Mather or any other oxide man will say that he does not get the kicks to-day that he got some years ago. Why? Simply because gas men understand how to use oxide better, know what produces caking and understand how to avoid it.

In investigating the percentage of caking in works such as those of the U. G. I. Company I found that the caking that does occur is so infrequent as to hardly make any difference. If, for the sake of the argument, however, the tendency to cake occurs in this particular box which I have suggested, if you will bear in mind the action of the oxide, you will see how it is self-curing. Assume, after the oxide is poured into the box that it has a tendency to cake; before it is gone through 25 per cent. of its use the oxide is poured onto the next tray, and any tendency to congest or adhere is entirely destroyed, because the oxide is dumped bodily onto the second level. If at that time it commences to cake again in the

second quarter of its use in its trip through the box, then at the end of the second quarter it is again upset and broken up, by being poured onto the next tray. *It does not get a chance to cake.* A third time it is broken up in that way before it passes out from the box. In other words any tendency to cake, from the time it enters the box until it passes out is neutralized at three different intervals in its passage through the boxes. Tendency to cake where occurring is largely because of using oxide in the boxes, without taking it out, by revivifying *in situ*.

In the form of boxes which I have proposed there are means for discharging the oxide rapidly and very conveniently. There is no object in trying to revivify in the boxes. When the occasion comes for revivification it can be discharged and revivified externally much better than by leaving it in the boxes.

Mr. Miller has made the point that in revivifying in the quadruplex box you throw out half of the capacity. I thought I made the point quite clear that in the larger works the box is to be so constructed that only one-third is thrown out of circuit for even a short time, the other two-thirds being always in circuit. There is nothing to prevent using four layers of oxide; these even only two-thirds in circuit yet give as much capacity as the three ordinary boxes in use with one at a time out for revivifying. That is shown by the figures.

I entirely agree with Mr. Bredel that the purification capacity of boxes depends directly upon the area assuming, of course, equal depth of oxide in each case. He speaks of oxide five feet deep; in order to make a comparison between boxes we assume the depth as a uniform factor in all such cases.

Mr. Somerville has said that in advancing something new I must expect to be "jumped upon." That is all right. I don't mind it. I do not think a man is doing his duty to the Association, who believes that he has an idea which will prove a betterment in any particular line of our business, if he does not advance it, even at the risk of being "jumped upon." I can stand it. I think, too, that history will show that a great many things that have worked out all right in the end, have been jumped upon the hardest in the beginning. I think I can understand the feeling of the water gas men twenty years ago! But I do not think that water gas stood still because the men who advocated it were jumped upon! I have advanced this scheme sincerely, believing

that the plan proposed for purifying boxes is a better one than existing methods. I quite admit that the details may have to be modified, to secure the best construction; but the internal gear and detail is something which can be comparatively readily shaped up. I have confidence, too, in the general scheme, possibly because of the degree upon which it has been jumped upon! If there was nothing in it, at least one of you would not take so much trouble to jump on it. I think you will yet see the "quadruplex purifier" demonstrate that the scheme has some good features in connection with it. I thank you for your attention.

MR. CORBETT—I think that every manufacturer of gas plants ought to give a vote of thanks to Mr. Shelton for his paper; I can certainly see something in that paper which is good, and I think if he is going to be jumped on for advancing those things it is a shame. Some remarks have been made about the oxide failing to fall through. Of course I do not know very much how oxide acts—the newest make of it—but I do know that the box in ordinary use can be improved. Speaking about metals deteriorating inside of the box, I may suggest that there are improvements coming on which will prevent that oxidation there. I feel that the matter should be taken up, and that some company should build a box like that proposed by Mr. Shelton. If there is trouble from the oxide caking at the sides, perhaps it would be well to build the box with sloping sides, and in that way get over that difficulty.

MR. A. C. HUMPHREYS—I move a vote of thanks to Mr. Shelton for his paper.

MR. BREDEL—Before that motion is put, I want to state that Mr. Shelton, in his paper, in comparing with the Universal Company's purifying plant, does not speak of series of four boxes. He knows very well that the purifying plant there is a system of two boxes each. If he can show the same square area in his two purifiers as he can show in the four purifiers he is correct; otherwise he is wrong. The area is not there.

The motion of Mr. Humphreys was adopted.

THE PRESIDENT—There is not enough time to take up another paper this afternoon, but we will occupy the time with a question from the Question Box, which the Secretary will read:

"What is to-day the most perfect and greatest commercial success in the application of illuminating gas for house heating furnaces? Also the best Bunsen burner for same."

THE PRESIDENT—I think that Mr. Blodget is now heating his own house by gas. Will he not give the convention the benefit of his experience?

MR. BLODGET—I have had experience with gas furnaces; but whether this question relates to the furnace which has had the greatest commercial success, or to the one which is the most perfect and effective, I cannot say. Mr. Crane, who is present, is a manufacturer, and he can give more detailed information than it is possible for me to do.

THE PRESIDENT—In a general way will you not state the results which you have reached in the use of gas in furnaces as compared with coal?

MR. BLODGET—I am using gas at \$1.25 per thousand feet, and find that it costs 50 per cent. more than coal at \$5 per ton.

THE PRESIDENT—We shall be very glad to hear from Mr. Crane.

MR. CRANE—I will first speak of the “Best Bunsen Burner for furnaces,” and will assume that the burner is intended to be used inside a coal furnace. The only place that I know of where such burners are used is in the natural gas regions. Many of you are familiar with the score or more varieties now used in that district. While many of them cannot be improved upon, still the most perfect one cannot be used economically in a gas furnace, even with natural gas at twenty cents per thousand feet. I have learned that natural gas bills under the above conditions range from \$20 to \$30 per month. The reason is that the conditions required from a coal furnace are, a large space for a body of coal, and a large air inlet and outlet to create and maintain a sufficient draft for combustion. The conditions for a gas furnace are the direct opposite, needing small space for the fire, and only outlet enough to pass off the products freely. Now, as it is a fact that Bunsen burners are not economical in a coal furnace, I will speak of the gas furnace. There are several of them advertised, but with only one exception (that I know of) they are all made of sheet iron. I have never heard of them being used anywhere but with natural gas. In point of economy they are only a little better than the coal furnace fitted with the Bunsen burner. If the sheet iron furnace was constructed so as to cool the products enough to produce condensation, the furnace would be rusted out in six months.

The question asked is: "What is the most perfect gas furnace on the market?" and "the greatest commercial success?" There is but one cast iron gas furnace on the market. It is made on scientific principles. As it is made of cast iron it will last for years. There are gentlemen present who have had them in their houses for four years. It is so constructed that all the heat is taken out of the gas that it is safe to take out, for enough heat must pass off to cause circulation. Testimonials have been given by several of the honored members of this Association. One of them kept a daily record of the temperature outside, and the consumption of gas required to maintain a temperature of 73 degrees in a house of nine rooms and hall. It shows an average of 778 feet per 24 hours for a period of five months. Another gives the average 820 feet for 24 hours for a period of five months to heat a large office. Both of these statements will show that it is not economical as compared with coal; but Mr. President and gentlemen, is it economy always to buy the cheapest article when you can afford to buy the best? As a matter of fact most of us have no choice, but are compelled to use the cheapest, and we cannot afford to run a gas furnace; but there is a large class who can afford to have, and do have, luxuries. It is right here that I think the Gas companies make a mistake. You have one of the greatest luxuries of the day, but instead of proclaiming that fact continually you are constantly depreciating the value of what you have to sell by comparing it with that old and faithful, but "back-number" friend, coal, which we all too well remember how we have shoveled, sifted, choked and shivered over one hour, and melted the next, the uneven temperature causing most of the colds, the wife's unending struggle with dust, etc. As to the gas furnace being a "great commercial success," that remains for you, gentlemen, and the gas companies at large to determine. I am an enthusiast, because I fully believe in it, and have proven my belief by my work. If I can get the same amount of enthusiasm in each one of you, gentlemen of the American Gas Light Association, then the "gas furnace" will be the "greatest commercial success."

MR. LITTLEHALES—I did not quite catch the quantity of gas used by the furnace in 24 hours. Will Mr. Crane state that again?

MR. CRANE—It showed an average of 778 feet per 24 hours for a period of five months.

THE PRESIDENT—Does any other gentleman wish to take part in this discussion? If not, and there is no other business, we will adjourn until to-morrow morning at 9:30.

Adjourned.

SECOND DAY—MORNING SESSION, OCTOBER 21st, 1897.

The Association met at 9:30 A. M.

The Secretary read the following telegram from President-elect Crockett:

SAN FRANCISCO, Cal., Oct. 20, 1897.

ALFRED E. FORSTALL,

Secretary American Gas Light Association.

Fort Monroe, Va.

Please convey my warmest thanks to the Association for the great honor conferred upon me to-day, and assure them that I will do all I can to advance its interests in every way.

J. B. CROCKETT.

THE SECRETARY—Yesterday a question was read to the Association which had been sent to me from Ottawa, Canada. When it was received, I wrote to Mr. Blodget and Mr. Crane, asking them to answer the question. So that Mr. Crane spoke yesterday in answer to that question, at my invitation, and the question and answer were not a put up job on his part, as some members seem to have thought. I make this statement in justice to Mr. Crane.

THE PRESIDENT—If you will now give your attention, Mr. F. B. Wheeler will read his paper on "Rust Deposits in House Pipes."

(For paper see appendix page xliii.)

THE PRESIDENT—We have had a most remarkable paper on a subject with which most of us, speaking from my own experience, are not at all familiar. We are all indebted to Mr. Wheeler for the trouble he has taken, and for the experiments he has made, as laid before us in his paper. It is now open for discussion. Will Mr. Ramsdell start it?

MR. RAMSDALL—I think that any paper of this character is exceedingly valuable to our Association, from the fact that it so thoroughly takes up a line of thought, and then, as it goes along, apparently settles the matter. There are some features of these calculations that are rather surprising—to some of us, at least. One is the very small amount of naphthaline which Mr. Wheeler

found in his examination; and it would seem from the fact that he attributes the taking up of the carbonyl of iron, at the time that the water gas was first started, to the fact that possibly this change may also have carried forward some of the naphthaline. Another feature which strikes me with particular force, is the small amount of deterioration found in this particular pipe. Long Branch is situated right on the coast, where we have all been taught that the greatest amount of deterioration to wrought iron material would take place, in a salt-saturated atmosphere, and where the atmosphere is so very moist; and yet his experiments demonstrate that the actual amount of deterioration there is almost infinitesimal. I did not figure out how long that pipe would last at that same rate, but it would apparently last for a great while. Mr. Wheeler does not mention it in the paper, but I take it for granted that these pipes were put up as any ordinary job of plumbing, and that there was no coating of the pipe at all?

MR. WHEELER—No.

MR. RAMSDALL—In that case the amount of deterioration which is established here (if his premises are correct) is certainly very low indeed.

MR. NEAL—I would ask Mr. Wheeler how he freed those pipes from this substance which he found there. He states that it was a very large building, and there must have been a great amount of piping. How did he clear the pipes, and especially the small ones from this substance?

MR. WHEELER—I will answer Mr. Neal's question by saying that we had to take pockets out of the floor and cut this pipe on every floor of the building. To give you an idea of the amount of work required I may say that it took nine men two days, and four men four days to work the whole thing through. Of course in the small pipes a great deal of the deposits were in the elbows and stopped them very easily.

MR. NEAL—Then there must have been considerable damage done to the house, and I suppose it did not pay you to do that work except to furnish a subject for a very interesting paper before this Association.

MR. WHEELER—I will answer that question by saying that if we had not done it we would have lost the sale of 275,000 feet of gas during the summer of 1897.

MR. LITTLEHALES—I would ask Mr. Wheeler whether this building had not been disused for a time? There is one feature in Mr. Wheeler's paper which struck me as rather remarkable and that is the statement that the corrosion is more likely to take place on pipes when in use than when out of use. My experience has been the very reverse of that. I have found that in a disused building, where the meter connection is usually open, the rust is more likely to accumulate. It surprised me to learn that he has concluded that the corrosion takes place faster when pipes are used than when disused. The same thing takes place in pipes, mains or services, having more corrosion because what little deposit will take place in services is from time to time either washed back or blown back in the main when the services are being cleared. I would like to ask whether this building had been disused for a long time.

MR. WHEELER—Yes, it had been disused for about eight months every year. I think there is no question but that the action you speak of takes place, because we found $2\frac{1}{2}$ pounds of iron rust in that one single place, which could unquestionably cause the difference between the assumed weight of the pipe and the amount of rust found as shown in that amount of deposit. So that the action you speak of certainly took place. But the question is to account for the amount of iron which was carried in there, and which did not belong to that pipe.

MR. C. H. PAGE, Jr.—I think that corrosion is largely due to the ammonia carried over in the gas. I remember one case where I cut out a four-inch line which supplied a business block; that line was evidently very heavily taxed because all the gas used in that block was taken through that pipe; it had been in service for 25 years, and it was found to be half filled with rust. I am sure that the gas was not thoroughly scrubbed during that time.

MR. SEARLE—I would ask Mr. Wheeler whether he ever used a Springfield gas machine?

MR. WHEELER—No, sir.

MR. SOMERVILLE—Have you had any experience there with lead pipe or composition pipe?

MR. WHEELER—No, sir.

MR. SOMERVILLE—I suppose if this had been a composition pipe this deposit would never have taken place.

MR. WHEELER—I think it would, because I have taken out two or three composition pipes in Schenectady, which had been in use for three or four years, and found an accumulation of rust; but they were in the street, and not in houses.

MR. SOMERVILLE—Had the fact that they were the old style of pipe anything to do with it?

MR. A. E. FORSTALL—Several speakers seem to have lost sight of one of the points of this paper. Mr. Wheeler acknowledges that there was corrosion in the pipe from the action of the atmosphere when the pipe was open; but he makes out a very good case that the weight of the pipe was originally 2.68 pounds per foot. The weight of the pipe, after cleaning out all the rust, was 2.41 pounds per foot. This gives only .27 of a pound per foot of pipe, for the iron lost by reason of atmospheric corrosion, only one-half of which was lost from the inside of the pipe. Now, he found inside of that pipe more than double that amount per foot, so that the iron must have been carried in from somewhere else. It could not have come from the pipe itself. It probably was not carried in from the atmosphere, for the atmosphere is never loaded with iron rust, except in certain kinds of factories. So the question is, where did it come from? If it was not carried in from the atmosphere, it must have been carried in by the gas when the gas was going through. To find out how that could be the case, Mr. Wheeler has made certain experiments, showing good reason to believe that that rust came in from the iron carbonyl.

MR. WHEELER—I would like to answer a question which came to me by mail from a member of the Association who was not able to be here. He asked me how much it would cost him to go through with some of these experiments, and if he could do it; and possibly it may interest some of the members to know a little something about that. With fifty cents worth of glass tubing, and a rubber pipe, any member of this Association, I do not care who he is, can sit down in his arm-chair and watch that rust being deposited right on the desk before him. All you have to do is to take a horizontal tube of glass and put it in a bath of cylinder oil, and put a Bunsen burner under it, and let the gas flow through, and after it has gone through for an hour, take it out, and you will find the carbonyl of iron deposited in the tube in plain sight. Of course, this is at a heat of about 530° F. It is a curious demonstration of the fact that the carbonyl of iron is sure to be found

where you are using iron sponge. If you want to make a series of experiments, you can start in with iron borings, and gas from your holder, determine the amount, and then try your oxide in use, and your new oxide in the same way, by passing a given quantity through, and then after you have completed the experiment, wash out this tube, weigh it carefully, and determine the amount. You will need a scale, which will cost you about \$12, and reagents, and glassware necessary for a number of quantitative experiments, which will altogether cost about \$20; but almost any gas works can scare up that amount of apparatus. So that by performing this experiment for yourself, you can determine with practice how much carbonyl of iron you are carrying to your consumers at any time. If any member would like to get up a freezing mixture, it is a simple thing to do. The apparatus is not much more expensive, but the experiment needs considerable more watching. I might say that the apparatus which I used in making these determinations, cost about \$700. It was loaned to me by a friend. The thermometers were graduated to tenths, and were very fine instruments. The balance cost about \$350. But you can perform the whole thing with an apparatus costing about \$20.

There is another thing I wish to speak about. In Mr. Doty's experiments (page xxxi), the temperatures are given in degrees of Centigrade, and in this paper of mine the temperatures are stated in Fahrenheit. If one is curious enough to take paper and pencil and figure out the Centigrade degrees in Fahrenheit, he will find a very curious uniform difference of about four degrees. The only way I can explain that is that in his experiment, the pure blue water gas with iron filings were used, whereas in my experiments I used the regular carburetted illuminating gas, which contained aqueous vapor and the illuminants.

MR. BEAL—I would like to say that possibly Mr. Forstall may be wrong. I think any Massachusetts member will remember that Mr. Whittier says somewhere:

“There is *iron* in our northern winds;
Our pines are trees of healing.”

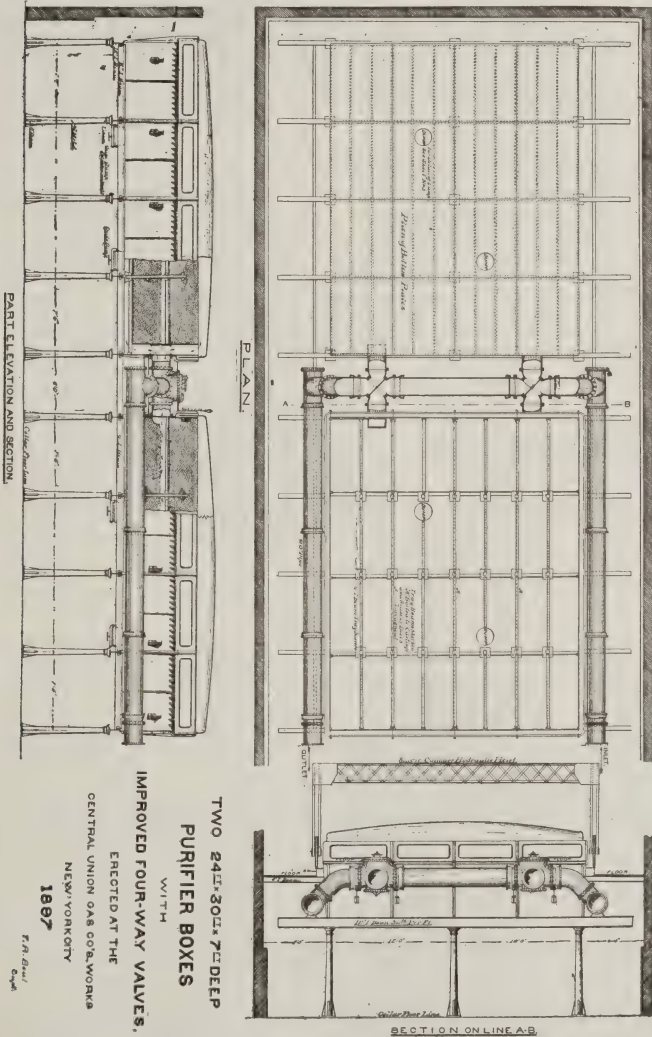
On motion of Mr. Doty, the thanks of the Association were voted to Mr. Wheeler for his paper.

THE PRESIDENT—There is a short topic prepared by Mr. Beal, on a new form of purifier, which would have been presented yester-

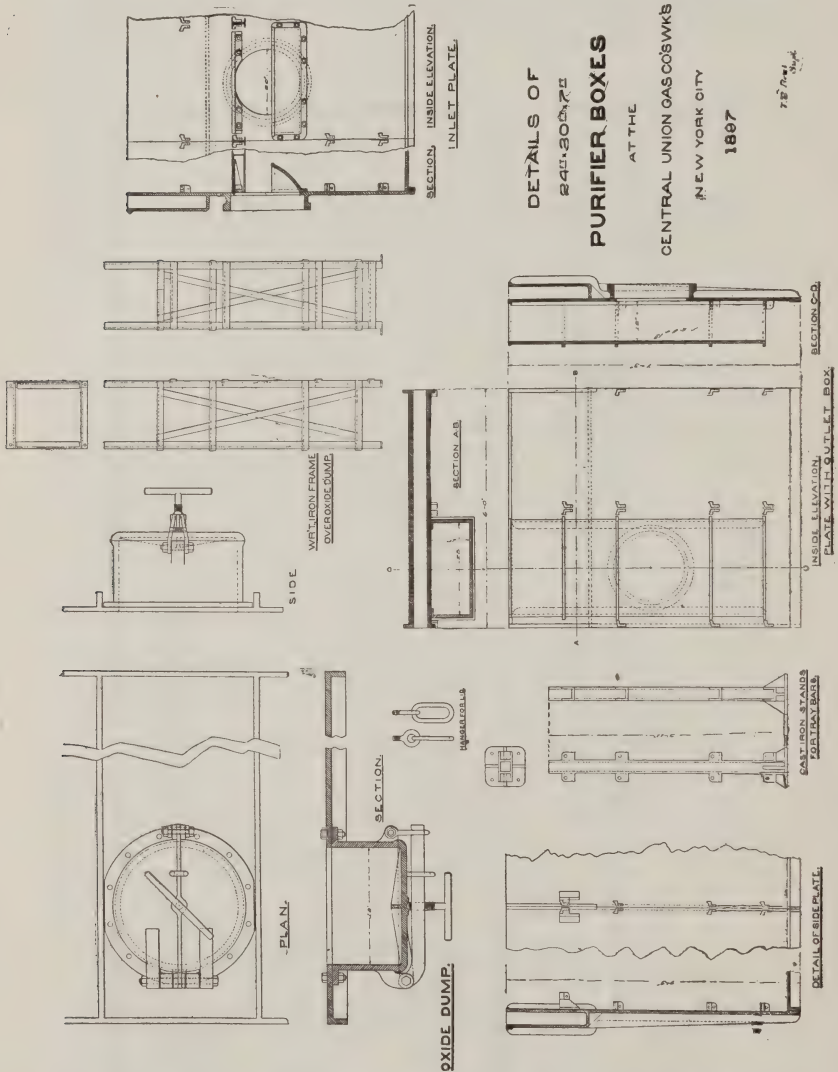
day, with Mr. Shelton's paper, but for his, Mr. Beal's, absence, and we will hear it now.

MR. BEAL—I should not have presumed to write this, but for the fact that a great deal of attention seems to have been given to the subject of purification.

PURIFIERS.

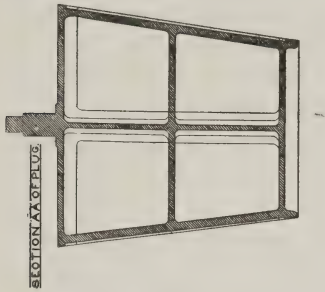


We have recently put in two purifiers, built after our own plans, which it may be interesting to refer to. The purifiers are 7' deep, 30' long and 24' wide. They were built in an old house 34' wide



inside, which, if it seems desirable, may be extended for other boxes. When so extended, boxes of greater depth will be put in.

The inlets (20") are opposite each other, and the outlets are also opposite each other between the two boxes, having centres midway as to the depth of the boxes, the connecting pipe being fixed



IMPROVED FOUR-WAY VALVE

FOR

24 IN. 300, 750 D.I.P.

PURIFIER BOXES

AT THE

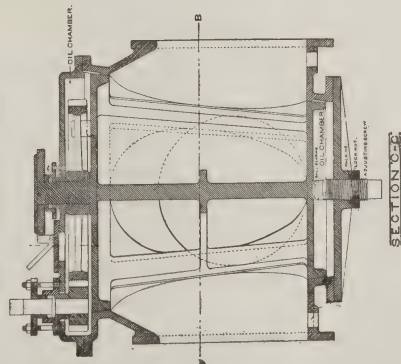
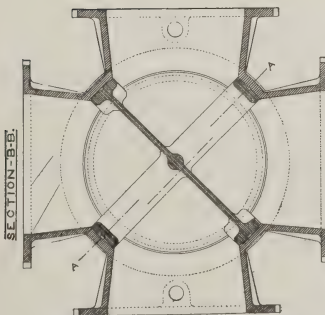
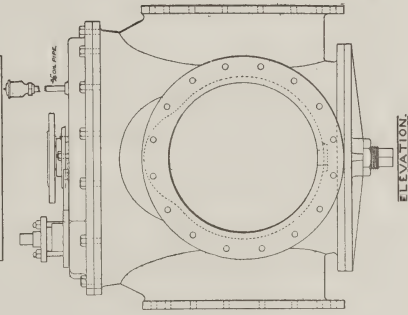
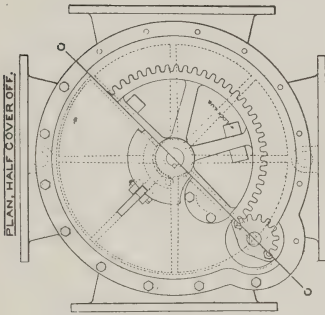
CENTRAL UNION CASCOSEWORKS.

NEW YORK CITY

1897

T.M. Bond
61/12

PAT. APPLIED FOR.



alongside the boxes on substantially the same plane, thus leaving all the space underneath entirely free of obstruction.

The flow of gas is directed by means of four-way valves, having many improved parts, which, we are confident, will make them work perfectly. Two layers of material are used in each box; the gas introduced between them, passing up through one and down through the other, and thence to the outlet pipe by a cast iron passage secured to the box and extending from the top of upper layer of oxide to and through the bottom layer.

In this passage are simple dampers to direct the flow of the gas through the different masses of oxide, to ensure the equal fouling of both if found necessary.

Two self-sealing outlets are fixed in the bottom of each box for convenience in emptying the oxide. Over these outlets, inside of the box, are cages which may be lifted out to enable the convenient shovelling of the oxide to the dumping outlets.

The four-way valves are easily worked by one man. All faces are covered while in use, and are thus protected from the action of the gas. All faces are also oiled through passages connected with a reservoir. The moving parts of the valves are supported on ball bearings. Provision has been made for raising the valve from its seat when necessary or desirable. Valves of this type have been used in this country and found to be unreliable. We are confident, however, that our improvements will prove to be valuable in practice and lead to their adoption.

The oxide will be raised by machinery from the basement to overhead bins, and thence distributed in the boxes by an adjustable chute.

Advantages of the system :

Every desirable combination of boxes may be used.

Lessened cost of building on account of reduced ground space required.

- “ “ “ covers—proportionate to depth of boxes.
- “ “ “ boxes, increased capacity being obtained by slightly greater cost of side plates.
- “ “ “ connecting pipes, and
- “ “ “ valve system.

Greater efficiency, on account of lessened speed of flow, being in the boxes described 50 per cent. of that in boxes of ordinary type occupying the same ground area.

Lessened pressure, due to increased surface and lessened friction in pipes and castings.

The boxes described were recently constructed for our Company, under the immediate supervision of Mr. T. R. Beal, our Superintendent, to whom is due the credit for improvements to the four-way valve.

THE PRESIDENT—Is there any discussion on this short topic?

MR. LITTLEHALES—I could not quite catch wherein the difference came in between Mr. Beal's method and the ordinary method, except in the increased depth. Will he kindly make it a little clearer wherein is the difference between that system and that in ordinary use other than the increased depth?

MR. BEAL—I regret very much if I have made the paper too short to be clearly understood. The inlets and outlets are along the sides of the boxes, so that the gas coming through the inlet is discharged between two layers. It is let in at the side. One advantage in this arrangement is in the fact that the pipes are out of the way entirely, and take up no room; they are alongside, and not under the boxes. Of course boxes of this kind can be made of any depth. If we put others in, we will probably make them ten or twelve feet deep. The idea is to get a slow flow of gas, as of course the best work in purification is obtained in that way.

MR. THOMPSON—The ordinary construction involves the necessity of using boxes in a consecutive order, as 2, 3, 4; then 3, 4, 1, etc.; but Mr. Beal refers to the possibility by his system of using them in any desired order, and not consecutively. I wish to ask if it is considered any advantage to do so, and if so, under what circumstances that could be of any advantage.

MR. BEAL—The question is not a new one to me. I never understood why you want to use four boxes. In fact we have got down to two boxes, and do not see any great advantage in four boxes in combination. Some people insist upon that, but we have never done it.

MR. THOMPSON—That hardly answers the point I make. In Milwaukee they are using upon water gas, purifiers with two boxes in a set. In St. Louis they have extended the capacity of the boxes by taking an ordinary four-box set and equipping them with four valves, with a proper piping system, and using two boxes in parallel and two boxes in series. But, suppose we were going to use

a three-box or a four-box set, would there be any advantage in being able to use them other than in the ordinary order?

MR. BEAL—I can see no advantage unless possibly one of the boxes might have more back pressure in it than another.

THE PRESIDENT—How much depth of oxide has Mr. Beal in each layer?

MR. BEAL—The space between each layer is one foot. That leaves six feet for material, and that space is pretty nearly taken up.

MR. LITTLEHALES—I move a vote of thanks to Mr. Beal for his paper.

Carried.

THE PRESIDENT—Is the Committee on place for holding the next meeting ready to report?

MR. MILLER—Your Committee has considered several places, and has finally unanimously decided to recommend Niagara Falls.

THE PRESIDENT—You have heard the report of your Committee. What is your pleasure?

MR. A. C. HUMPHREYS—I move that the report be adopted.

MR. LITTLEHALES—I second the motion.

Carried.

THE PRESIDENT—The motion is carried and our meeting next October will be at Niagara Falls.

Is the Committee on Research ready to report?

Mr. A. S. Miller read the following;

REPORT OF THE COMMITTEE ON RESEARCH.

To the American Gas Light Association :

GENTLEMEN—The first subject taken up by your Committee was the adoption of a standard for house piping. The old standard that has been in use for many years by the companies distributing coal gas is as follows :

Size.	Length Allowed. (Feet.)	No. Burners.
$\frac{3}{8}$	20	3
$\frac{1}{2}$	30	6
$\frac{3}{4}$	50	20
1	70	35
$1\frac{1}{4}$	100	60
$1\frac{1}{2}$	150	100
2	200	200
$2\frac{1}{2}$	300	300
3	450	450

Allowing six feet of gas per hour to a burner this table seems to be figured for gas of a gravity of .420 and a loss of pressure of 0.1" within thirty feet. The following will show the capacity of pipes of the length and diameter given in the foregoing for gas having a specific gravity of .420, .550 and .680, the loss of head in each case being .1 inch in 30 feet.

Tables showing amount of gas that will be delivered in one hour through pipe of given size and length with a loss of pressure of one inch of water in three hundred feet :

SPECIFIC GRAVITY OF GAS.				
		.420	.550	.680
Size in inches.	Length in ft.	Cu. ft. per hour.	Cu. ft. per hour.	Cu. ft. per hour.
$\frac{3}{8}$	20	18	15.6	14
$\frac{1}{2}$	30	37	32.2	29
$\frac{3}{4}$	50	101	88	80
1	70	210	180	162
$1\frac{1}{4}$	100	360	310	280
$1\frac{1}{2}$	150	577	500	450
2	200	1200	1030	930
$2\frac{1}{2}$	300	2050	1800	1610
3	450	3300	2850	2560

After discussing this subject your Committee has concluded to refer it to the Association for discussion before bringing in a final report. The question to be decided is "What Should be the Maximum Loss Allowable in 100 Feet of House Piping?"

There seems to be no special reason for changing the diameters and lengths given in the old tables so, when the loss of pressure has been agreed upon, it will be easy to determine a standard.

Your Committee has been in correspondence with the foundries which had agreed to adopt the standards for works and street main specials which were recommended by the Society of Gas Lighting. There seems to be some demand for specials made according to these standards, but they have not been taken up to any great extent. The specials made according to these standards seem to be satisfactory, but the subject is one that deserved more study than has been given it, and your Committee respectfully requests that it be allowed to wait until next meeting before making a final report.

Your Committee respectfully recommends the adoption of the United States Standard Gauge for sheet iron and steel plates,

which gauge was made a United States standard by Congress in 1893.

In the line of research two papers have been secured for this meeting, viz.: "Report on Burner Stoppages," by Mr. Paul Doty, and "Some Further Experiments on Interior Illumination," by Mr. Alten S. Miller.

The following subjects are of interest to the members of the Association, and your Committee would like to have papers on one or more of them for the 1898 meeting :

The measurement of high temperatures.

The self-enrichment of coal gas.

The production and separation of cyanides.

The effect of the depth of fire on the practical efficiency of a water gas generator.

The removal of tar from water gas.

The effect of regenerative benches and anti-dips on the production of ammonia.

The loss of illuminating power of 25 to 30 candle gas when mixed with air.

The point has often been made that it is easier to write a paper than to find a subject. Many of the members of the Association should be in position to make investigations on the above subjects, and your Committee earnestly requests that such as can do so will volunteer.

ALTEN S. MILLER,

C. F. PRICHARD,

GEO. TREADWAY THOMPSON.

THE CHAIRMAN (Mr. A. C. Humphreys)—You have heard the report of the Committee on Research. What is your pleasure? I understand Mr. Miller to say that he wishes to have a discussion on one of the features of the report, and one point he wishes to recommend for adoption.

MR. MILLER—The Committee recommends the adoption of the United States Standard Gauge.

THE CHAIRMAN—The subject of Specials you wish referred back to the Committee?

MR. MILLER—Yes.

THE CHAIRMAN—We will first take up the question of the adoption of the specific recommendations made by the Committee.

The first is as to the Standard Gauge for Steel Plate and Sheet Iron. What is your pleasure with regard to that?

MR. LITTLEHALES—I move the adoption of the United States Standard Gauge.

Carried.

THE CHAIRMAN—Now, in regard to the Pipe Specials, the Committee requests that this subject be referred back to them for another year. Does that meet with your favor?

MR. BEAL—I move that it be so referred.

Carried.

THE CHAIRMAN—Now, Mr. Miller would like a qualified discussion on the question of House Piping.

MR. SOMERVILLE—I would like to suggest the adoption of a rule that no $\frac{3}{8}$ ths horizontal pipes whatever be used for house piping. I think it is wrong—and emphatically so after we have listened to the paper presented by Mr. Wheeler.

MR. MILLER—The question as indicated is, "What should be the Maximum Loss of Pressure Allowable for One Hundred Feet of House Piping." The old standards which have been used for a number of years, and which apparently gave satisfaction, allowed a loss of .1 of an inch in 30 feet. That seems to be a very great loss of pressure. At the same time it is very seldom that a building is run to its full capacity. In designing an electric light plant they do not design it large enough to take care of all the lamps that are expected to be on it, figuring that the whole city, or the whole building, never will be lighted at the same time.

In piping a house it is not necessary to consider that it will often happen that all the burners in the house will be in use at the same time; nevertheless, to the Committee it seemed that .1 of an inch for ten yards was a very considerable loss of pressure. I hope that some of the members will express an opinion, and that the Association will make some recommendation as to their wishes in this matter. In figuring out this thing we have five unknown quantities and one equation, so that it is impossible to determine any one quantity without assuming the other four. We will assume the length and the diameter to be constant, and also the gravity; that leaves us to assume the amount of gas or the pressure. So that the question is, "What pressure shall we assume?" I hope that we shall hear from some of the members on this point.

MR. DOTY—In electric wiring good practice allows a maximum loss or drop in pressure of 2 per cent., when the building is entirely lighted. The 10 per cent. drop suggested would be with the higher main pressure in use to-day an important loss. It seems to me a 5 per cent. drop in thirty feet is all that should be required. This would be with an initial pressure of 1.5", a drop of .1" in 40 feet.

MR. MILLER—A 5 per cent. drop is an unknown quantity. It could not be incorporated in a table, because probably no two companies have the same pressure. It must not be a percentage, but an absolute drop. The members should figure on that basis—that the drop would be absolute and not a percentage.

MR. LITTLEHALES—I thoroughly endorse Mr. Somerville's suggestion that $\frac{3}{8}$ ths inch horizontal pipes should be entirely eliminated. I think if that could be made the understanding, it would be an excellent thing. A $\frac{3}{8}$ ths inch pipe is all right enough for side brackets, where the pipe is vertical, but I think that $\frac{3}{8}$ ths inch piping should be eliminated altogether in horizontal work.

MR. W. FORSTALL—In this case you have got to suit a majority of the companies all the way through. Suppose you have a burner pressure of ten-tenths, then you must estimate how much you can afford to lose in the building and make an absolute table of it. To do this you have got to decide that the average pressure at the works will be so much, say thirty-tenths down to fifteen-tenths, and that you will have a drop on your line of a certain amount. You have got to work it out in that way, which is really a very arbitrary way of getting at it, but I think there is no other way of doing it.

MR. SEARLE—The Committee are evidently cracking the hardest nut they ever had to crack. The handling and selecting of piping is a very broad subject. It is impossible to settle on a maximum illumination from a given standard, because the time selected would perhaps be an hour when the amount consumed would require a pressure which would upset the entire standard arrangement of piping. You might in an individual case put in the largest pipe you could possibly induce a plumber to install.

MR. SOMERVILLE—That is why I plead for a large factor of safety. It is a most necessary thing. Of course, I understand the predicament the Committee is in. It is difficult for them to decide

the question. But it will not do to figure too closely on this matter. As I said before, we must allow a large factor of safety, because in a small pipe, or in any kind of pipe, a piece of rust, or of white lead dropped into the pipe, entirely overthrows your calculations, for then the diameter is reduced nearly one-half. So I think that we cannot go wrong in increasing the size of the pipes largely to overcome this objection. The increase does not cost much more. It is the cost of laying the pipe in the first place that counts, not the cost of increasing the size.

MR. SEARLE—The adoption of a standard for house piping is to be compared with the adoption of a standard set of mains for a given company.

MR. A. E. FORSTALL—It seems a shame that we should not give the Committee a direct answer to their question. I think that .1 of an inch to thirty feet is rather small. The whole thing is arbitrary and empirical. Why, then, should we not take .1 in 100 feet. As Mr. Littlehales has said, the extra cost of larger pipe is infinitesimal as compared with the cost of the whole job of piping a house; and .1 in 100 feet would probably mean only .1 of an inch loss in an average building. It is only to average buildings, of course, that a standard of piping can apply. When you get to buildings above the average, where you have runs of over 100 feet, each case has to be settled on its own merits. I think we can safely instruct the Committee to adopt a standard of .1 of an inch drop in pressure in 100 feet of piping.

MR. NEAL—I have been lately informed that by a recent ordinance of the City of Boston, or by a recent statute of Massachusetts, all plumbers and gas fitters are required to be licensed after an examination. My attention was called to the matter by a communication received from some one who represented, I believe, a plumber's firm, who do business in the way of furnishing gas pipe for houses and putting it in. In that communication the question was asked of me whether we should require an inspection to be made after the inspection made by the authorized agent of the City of Boston; and if that is the case, the pipe is to be examined by those who are in the employ of the municipality. I do not know whether the city or the State authorities are to have charge of this but whichever it is, they will probably fix and require a standard. The fact that such an ordinance or law has been passed was new

to me, but after receiving that communication from quite a noted firm who are engaged in gas-fitting business, I looked into the matter and found that it is so. If it is really the case that the City of Boston (and I judge that it is the city and not the State) will require the inspection, they will probably fix the size of pipe to be used in houses and other buildings. Is there anyone here from Boston who can give any information on that point? If they do fix a standard, and if they test the pipe by that standard, they will probably at first be very careful. At present, under a commission, all our electric wires are examined and tested before the current can be turned on.

MR. C. J. R. HUMPHREYS—I am under the impression that the English rule requires a gas company to deliver gas at the main at one inch pressure, and it runs in my mind that that was arrived at in this way: .3 for friction in the pipes, .3 in the meter, .4 at the burner. It runs in my mind that that is the way, but I have no doubt that the President is better posted on that than I am. I should be very glad to know if there is such a rule, and whether I am right in my understanding of it.

As to Mr. Forstall's suggestion: I think that 100 feet to an ordinary house would be too small a figure. I think that a drop of .1 of an inch pressure in 30 feet of piping would be pretty nearly right. If you are going to adopt any rule I doubt if you could get much closer to it than that. We should remember that while it is nice to get the pipe as large as possible, yet in many cities we have to run up against the architects, who will not allow, except in few cases, any notching out of the beams; they try to get the pipes run between the upper and lower floors as far as possible and put in a great many risers, and we have a good many instances where we would like to put in a half-inch pipe, but the architect insists upon having only a $\frac{3}{8}$ th inch pipe.

THE CHAIRMAN—I presume in connection with what Mr. Neal has been saying with regard to the rules which may be adopted in Boston concerning the size of pipes, even if such rules were adopted, the authorities would be only too glad to be able to refer to rules already adopted by this Association. I am not posted with regard to the English rule, but I dare say that Mr. Miller has ascertained it in connection with his investigation.

MR. MILLER—Your Committee was not aware of the English rule when this subject was under discussion. As the farthest

burner from the meter could not, in an average house, be over 90 feet away, the distance being measured along the pipes, this would check with the .3 mentioned.

MR. NEAL—Did I understand Mr. Humphreys to say that this was in the Blue Book? If so, it is a State law.

MR. C. J. R. HUMPHREYS—I think this rule was the result of a Parliamentary investigation made many years ago. It was in one of the English Blue Books. The question first arose as to what pressure a gas company should be required to maintain at the point where the service is tapped into the main; and I think it was fixed at one inch, and that it was arrived at in the way I have stated. A good many experts were called into the investigation and one inch was arrived at in that way. That is my recollection of it, but it is a good many years since I read the account.

THE CHAIRMAN—The question before us now is: Are we ready to take action to-day in the way of instructing the Committee as to the loss of pressure to be allowed? That is all we are asked to do at present. I presume that they will then ask that the subject be referred back to them to make a final report in the line of that instruction.

MR. A. S. MILLER—When the loss of pressure is once determined the table is practically completed. The Committee does not recommend any changes in diameters or lengths, but only in the loss of pressure. When that is determined we will complete the table, and then we can have the tables made out and incorporated in the minutes.

MR. SHERMAN—Referring to the question which Mr. Neal asked with regard to legislation in his own State or city I would suggest that if Commissioner Barker is present he would be able to throw some light on the point as to what the last Legislature did on this subject. If my memory serves me correctly the legislation was called up by the large number of deaths which it was claimed were brought about by the leakage of gas from inside pipes, and this legislation was designed to regulate this matter. If Mr. Barker is present he would be able to give us a statement of what the legislation was.

THE CHAIRMAN—The point is not vital to the present discussion and so we do not need to worry about it.

MR. WARMINGTON—I move that the Committee be instructed to estimate the loss at .1 of an inch on 50 feet of pipe.

THE CHAIRMAN—It has been moved and seconded that the Committee be instructed to prepare their tables upon the basis of a loss of .1 of an inch in pressure on 50 feet of pipe. The question is open for discussion.

MR. SOMERVILLE—I move as an amendment that we call it 100 instead of 50; .1 of an inch loss on 100 feet of pipe.

MR. LITTLEHALES—I second that amendment.

THE CHAIRMAN—Then the question is on the amendment to instruct the Committee to prepare their tables upon a loss of .1 of an inch in 100 feet. Are you ready for the question?

MR. A. S. MILLER—Mr. Humphreys has made the point that we have not always been able to get in just the size of pipes that we would like to have; but it is not well to connect pipes any larger than is necessary. The rule of .1 in 30 feet has been in use for a great many years, and there are many houses which are piped with very much less allowance than that. There are lots of half-inch risers in a great many of the cities which are doing a great deal of work. I think that .1 in 50 feet, as moved by Mr. Warmington, would be a pretty fair allowance. It would be going a great deal beyond the custom of many years. I may also say that a great many houses are piped on the basis of .1 in 30 feet for coal gas, but which are now using water gas of probably .65 to .68 gravity; and the capacity of pipe for that gas would be less than 80 per cent. of what it is with coal gas. I do not think there has been any special complaint as to the rule except in places where the houses have been extended and the piping tacked on indefinitely, as is usually done in such cases. When a house is extended a lot of pipe is often added without ever considering whether originally there was sufficient pressure for the size of pipe first put into the house, but I think as a rule there has been no serious complaint where the houses were piped according to this table in the first place.

MR. SOMERVILLE—The point I have in view was not so much the lighting of the house, but let us remember that there are other things for which we use the gas coming through those pipes now, as in the case of gas stoves. The conditions are entirely altered from what they used to be. I submit that the capacity of pipes nowadays ought to be double, or nearly so, in order to fill the

changed conditions required from them. I think this is one of the most important subjects that can come before the Association; because my experience has been that the greatest trouble we have had about poor lights, or about the gas not being just right, has come from this point alone—that the pipe is too small, or is choked up. This is especially the case when they begin to put on the gas stoves; the pipes sometimes then fail altogether. Now that we have a chance for acting on this thing, it is well for us to look to the future. Gas lighting is only in its infancy, and we do not know what may be required of those pipes.

MR. COWDERY—We should bear in mind that extensions have often been made to house pipes which have resulted in the system being entirely too large for the pipes. We have got to calculate that an extension will be made to such a system; and if we can adopt a system to start with which is quite as large as at present, it will come out all right when the extensions are made. I think it is wise to do that.

MR. DOTY—Why not compromise on the figures suggested, and instead of 100 take 60, which is above the present standard, which seems to satisfy Mr. Somerville. Why not take .1 drop in 60 feet?

MR. NEAL—Although my company is furnishing both coal gas and electric light, I am glad to hear the remark of Mr. Somerville. I have heard it before. It is quite common for us to hear it said that the electric light is in its infancy; and now I am very glad to hear the remark that gas light is in its infancy. I believe that it is. From the discussions, and from the reports of committees which I have read and heard, it seems to me there ought to be a sliding scale. The piping in a case where the gravity is about .42 should be on one scale, with an allowance for drop; and then for a mixture for water and coal gas—which is the gas furnished by my company (33 per cent. of water gas and the balance coal gas) there should be another and different allowance of drop.

THE CHAIRMAN—The Committee have that in mind, but they want positive instructions as to the pressure which will enable them to do that very thing.

MR. NEAL—I was only going to add that in the city of Boston it is clear water gas.

MR. THOMPSON—The Committee has already taken into consideration the several gravities of gas: .42 for coal gas; .55 for mixed

coal and water gas; .68 for water gas; and that point will be provided for by a triple table—each part giving the equivalent for the kind of gas to be taken into question.

Replying to Mr. Somerville, I may say that the fall of pressure due to the use of stoves is usually provided for by special piping running from the meter.

As to Mr. Cowdery's remarks, I may say that while I am entirely in sympathy with the feeling that the pipe used ought to be amply large, yet the number of houses which are extended after construction would form a very small percentage of the total that would have to be provided for. It seems to me that as between the 100 feet suggested by Mr. Forstall and the 30 feet as at present used, 50 feet is the more desirable; and I think that that will give ample capacity, and is one which it would be well for us to adopt as a standard. We must not overlook Mr. Miller's suggestion that, as in electrical practice, it very rarely happens that all of the lights will be burning at once.

I hope that the amendment will not prevail, but that the original motion will be passed. I call for the question.

MR. LITTLEHALES—I do hope that a triple standard will not prevail. I think it would cause endless complications. And then, this great difficulty will arise: The tendency will be rather to go from coal gas to water gas than from water gas to coal gas. Now if the smaller size of pipe is used for the lighter gas we cannot change the pipes afterwards for the heavier gas. It is far better to have a system at the start which will be amply sufficient, and have larger capacity for the heavier gas, and then the lighter gas will take care of itself. Let us have one standard only.

THE CHAIRMAN—I do not want to cut short the discussion of such an important topic, but our time is limited. Are you ready for the question on the amendment? You will understand that we have first a motion to instruct the Committee to base their tables upon the loss of .1 of an inch in 50 feet of pipe; and Mr. Somerville offers an amendment to change it to .1 to 100 feet. We are now voting on the amendment. All in favor of the amendment, namely, to make the loss .1 to 100 feet, will please rise and be counted; those who are contrary minded will rise. The amendment is lost. The vote is now on the question as originally offered, namely, that the Committee be instructed to prepare their

tables based upon a loss of .1 of an inch in pressure to 50 feet of pipe. All in favor of that motion will say, Aye; contrary, No. The motion is carried, and the Committee is so instructed.

The Committee would now like to have this subject referred back to them, in order that they may prepare their final report in accordance with this instruction.

MR. BEAL—I move that it be so referred.

Carried.

THE CHAIRMAN—It would now be in order to adopt the report as a whole and continue the Committee.

MR. BEAL—I make such a motion.

Carried.

MR. EGNER—I move a vote of thanks to the Committee on Research for the labor they have bestowed on this work during the past year.

THE CHAIRMAN—It gives me great pleasure to put that motion, because I believe that we have here the start of some very good work for this Association. I think we can follow subjects up in this way better than by any other method.

Motion carried.

THE CHAIRMAN—If Mr. Cowdery is ready, we will now hear the report of the Committee on the President's Address.

Mr. Cowdery read the following:

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Gentlemen: Your Committee feels that unusual commendation is due our President for the very thorough and exhaustive manner in which he has brought to our attention the various subjects presented for our consideration.

His words of appreciation for the work of the Committee on Education are so heartily endorsed by all of the members of this Association that this Committee wishes to emphasize them. We are sure that all of the members join with the President in extending words of gratitude to the members of that Committee.

Your Committee also wish to call attention to the figures presented by the President on the output per capita. These figures are compiled in a way that makes them very useful to study, and many lessons may be learned on their careful perusal. Each of

the subjects touched upon might well be given a special mention, so well has he brought out the useful points under each subject, but in this respect we feel it unnecessary for us to do more than congratulate the President upon his work, and many times congratulate the Association upon having placed a man in the President's chair who could and would bring to their attention so many useful and interesting thoughts.

Respectfully submitted,

E. G. COWDERY,
J. H. JOURDAN,
C. F. PRICHARD,
Committee.

On motion of Mr. Doty, seconded by Mr. Neal, the report was adopted and ordered spread on the minutes.

MR. NETTLETON—I would like to make a motion in respect to a vote taken yesterday, directing the Secretary to print the address of the President in pamphlet form. I move that that action be rescinded. I do this for the reason that the address will appear in a very few days in the "Gas Journal," and in that way will be in your hands as soon as if printed in pamphlet form; and besides, I wish to save the Association the expense. I state this without intending any reflection upon the mover of the resolution. I appreciate the kindness that induced him to make the motion; but I would very much prefer to have that action rescinded.

MR. SOMERVILLE—I second the motion.

Carried.

THE PRESIDENT—You will now give your attention to the reading of the paper entitled "Chemical Notes on Purification," by Mr. Mather.

(For paper see appendix, page xxxvii.)

THE PRESIDENT—We have listened to a very interesting paper, and the subject is now before you for discussion. Will Mr. Miller start the discussion?

MR. A. S. MILLER—I read this paper with a great deal of interest, and I think the subject is pretty well covered, and that there is not very much that I can say in connection with it. I notice that the author refers to an old condition, which has been bothering me for a long time, and that is that the condition of most gas

works is such that you have to use boxes to scrub the tar; he suggests that you use that room for oxide. So far as I know, it has never yet been determined to just what depth it is an advantage to pile the oxide in a box, or through how many lineal feet you should put the gas. In the discussion yesterday, the point was taken that it was a great deal better to put the gas through boxes in parallel, through two sets of boxes, of two each, than put it in tandem through one set of four boxes. There must be somewhere a maximum, or rather a minimum, where these two methods would meet. For instance, a certain amount of gas might be equally well worked in tandem or in parallel; if you get more gas, it might work better in parallel; if you get less gas, it might be better to put it through the boxes in tandem. That would have a bearing upon this subject—whether, if you have a certain amount of oxide to put the gas through, there would be any advantage in putting it through more oxide; or whether that room might not just as well be used for the scrubber. Suppose, in designing a gas works, you are content to design boxes big enough to use them as scrubbers as well as purifying boxes, then the question would be whether you could do so with advantage. I do not know that this method of construction is one which should be particularly recommended, but I would like to know whether Mr. Mather has any data to show whether they could or could not be so used to advantage. Another point has been raised—as to blowing *up*, or *down*. There have been adherents to both methods. I have always taken the position that it is better to blow *up*. At a recent meeting of the Western Association, the consensus of opinion seemed to be that we ought to blow *down*. There does not seem to be any special reason for doing either way. I would like to know whether there are any special reasons beyond the fact that to blow up would tend to loosen the oxide, whereas blowing down would tend to pack it? Referring to the method of revivifying oxide by piling it on grids, I would say that we have a hard time to keep the oxide from getting on fire; and if we should give it a good draft, I am afraid we would have to keep a man there with a hose all the time. Of course, after oxide has been used for a long time, and has, to use a popular expression, lost its life, or a great deal of its life, it might be hard to revivify. Such an arrangement might then be used with advantage. But I would hesitate to revivify any new oxide in such a manner, because I would be afraid it would get on fire.

MR. LITTLEHALES—I think the paper which Mr. Mather has submitted is very valuable, especially in the fact that it brings more forcibly to our minds again what Mr. Forstall presented at the last meeting, and that is the advantage gained by purification at higher temperatures. I had a singular illustration of the view of Mr. Forstall recently, in making some experiments in a glass purifier. The little purifier was exposed to the sun, and strange to say on the side on which the sun shone the oxide blackened in half the time that it did on the other, showing that the quicker chemical action took place under the higher temperature. I am perfectly satisfied from the observations that most of us have made that in the summer time our purifiers as a rule purify much more per bushel than they do in the winter time; part of which is probably due to the slower speed of the gas going through, and part of which is undoubtedly due to the higher temperature. But there is this drawback and disadvantage to the heating of gas in the purifiers, our unaccounted for gas is liable to be increased unless the difference in bulk is corrected for the temperature. The value of increasing the temperature in purification, as far as the increased work per bushel of material is concerned, is, I think, beyond question.

DR. BIRCHMORE—The title of this paper is “Chemical Notes,” but so far it has been a pure case of mechanics. I would like to draw attention to certain matters in connection with it that concern me from my standpoint quite as much as it does men in the gas works. Mr. Doty spent a very considerable part of his time the first day of this meeting in making as plain as possible that the form of oxide he wished to make, and probably did make, was the oxide which takes the form of $\text{Fe}_2 6\text{OH}$ —the form which is denied existence here in this paper. The notation which Mr. Mather has copied from King’s Treatise is a notation as old as the hills, but it does not alter the chemical fact. Mr. Mather simply has not gone over the work far enough to notice that his statement and this statement are exactly alike if he will just turn them about a bit. We have talked over this thing a little, and I think I am not saying anything here that I have not already drawn Mr. Mather’s attention to. That equation of King’s is the equation of all the rest of them, barring the simple change of notation. There is no difference there until you come to the last one of the two, which is said to be authoritative. That may be authoritative, but it is

wrong. It does not make any difference whether it has a great name attached to it or not. It cannot be diagrammed. There is no way in which that can be put together to express the facts which are known to every one of us. Mr. Doty's experiment showed conclusively what kind of oxide of iron he made, and what kind he intended to make. I would not wish to say it as a matter to "prove on the table" here, but I could prove it without very much trouble, that unless there was some of Mr. Doty's form of oxide with the 6OH there would no reaction take place, and more than that there is a supposition of purification behind all this which is left out. When you pass chemically pure sulphuretted hydrogen over freshly made oxide, made as Mr. Doty and Mr. Wheeler make it and refer to it, you produce immediately a minus pressure. The absorption is so very rapid with it that the reduction goes on faster than you will supply it from the ordinary kit as used. More than that; in the oxide from the pans Mr. Mather told me that, with a microscope using 1,000 diameters, he had distinctly seen sulphur as such. If the mixture is in the proportions laid down here, the color of the mass would not be black, but would be of an orange brown. I asked Mr. Doty what the color was, and he said that it was black. Therefore, it is inconsistent with the physics of the case to suppose that Fe_2S_3 and $2\text{FeS} + \text{S}$ are mixed in any possible way in the boxes. That goes, because we cannot imagine that sulphur, in the shape that Mr. Mather saw it, could be mixed with the other, and not have an effect upon the gross mass. So that one or the other of the two statements has got to be modified. Either Mr. Mather's experiments, which were made in a tube containing 50 cubic centimeters of the oxide (his own statement to me) did not reproduce the condition of the pan, or else there is something else wrong with the chemistry of it. I have not been able to reproduce Mr. Mather's experiment because I did not know of it in time, but I did reproduce Mr. Doty's, and I know that the statement as to minus pressure is exactly as I have made it. It is $2\frac{1}{2}$ millimeters under ordinary circumstances when the proportions used are as 8 to 1.

THE PRESIDENT—We have with us to-day a gentleman who is quite conversant with this subject, and who is a manufacturing chemist. Although he is not a member of our Association, if there is no objection I will call upon him—Mr. Herman Pool.

MR. POOL—I thank you, Mr. President and Gentlemen for the courtesy. I congratulate Mr. Doty that in the reading of his paper yesterday he very carefully omitted a chemical formula which we have before us. My idea, and my action, in connection with other chemical scientists is to touch on the technical points and leave out the theoretical points—to study them when we get home and have plenty of time to do it in. So I do not think it is necessary to say very much on the theoretical points which have been referred to; but there are one or two things in the treatment which has been brought out in the last report of the British Chemical Society, which has a bearing upon the work here. The British Government obliges all the chemical works to make such arrangements that as little nuisance as possible will be produced. Of course, in the making of sulphate of ammonia from ammoniacal liquor, there is an enormous quantity of sulphuretted hydrogen given off. Most of the British works to-day are passing that into sponge, and they find that not only have they originally a certain amount of sulphur there, but they also have an amount of sulphur which runs up in some cases to seventy per cent. in the sponge, which is solvable in the bi-sulphide of carbon; and, in addition to that, as much as eight per cent. of the entire mass has been combined in the form of FeS_2 , or what is popularly known as iron pyrites, and which under revivification does not liberate sulphur at all. I asked Mr. Mather, yesterday, if, in making examinations of old sponge, he had found any sulphur which was not available, that is, sulphur which would show in the total sulphur by oxidation, but would not show by a solution, and which is supposed to have been rendered insoluble in some molecular state. The subject of heating, while the action is going on, has been touched upon in the same quarter. In the gas, of course, the sulphuretted hydrogen is very much diluted. With the English treatment, they have comparatively pure sulphuretted hydrogen, and the action is a great deal stronger. They have found a decided increase of temperature there, and the explanation of why we do not get an increase of temperature in gas purification, is that the sulphuretted hydrogen is so largely attenuated, and there is a large amount of aqueous vapor being carried with the gas. I think that Mr. Littlehales' experiment, where he used the sunlight, gave results which were due perhaps not so much to the increase of temperature as to the actinic action of the sun, as he will understand if he will recall the

action of the sunlight on silver salts, and on the bi-chromite of potash; and which action we also get with the Welsbach light.

MR. THOMPSON—As to the criticism that there was danger of burning up the grids, even in ordinary purification, I would suggest that the danger was probably due to an imperfect oxidation of the sponge; and that with a perfectly oxidized mass he would not have such a vital increase of temperature as to render it dangerous. In the case of old oxide, it might be possible to still further enhance the revivifying effect by combining Mr. Forstall's suggestion with that to which Mr. Mather calls attention in the English practice, namely, by putting a series of coils for steam beneath the grids on the floor during revivification. In other words, by producing in some degree a draft upward through the oxide. Mr. Mather calls attention to the fact that the revivification is greater upward than downward—a very important point, and one that we would altogether fail to avail ourselves of in ordinary revivification on the floor. In a paper read before the Association some years ago, I called attention to the great advantage of exposing oxide during revivification to that potent agent, sunlight; and I was going to raise that point before Dr. Birchmore spoke.

MR. WHEELER—I am very glad indeed to see Mr. Mather mention so pointedly the use of planer chips. It seems to me that is one of the most vital things in the use of sponge—the use of chips; and where gas works are using planer chips I do not think they have very much trouble from caked oxide.

MR. THOMPSON—I heartily agree with Mr. Wheeler as to the very great advantage of planer chips, but I have found one difficulty in making up oxide with planer chips, and that is the fact when you are turning over in process of manufacture particles of iron rust will sometimes be blown about by the wind, and when you use the planer chips in the manufacture of oxide you are apt to find some unoxidized iron.

MR. DOTY—The practice at Long Branch and at Paterson where planer chips are used, is to cover or coat the chips with oxide of iron made from copperas. The chips when wet are mixed with iron which had previously been thoroughly rusted and then wet down in a separate heap. In this way the iron rust is not blown about by the wind, and there is no unoxidized iron present. Mr. Wheeler makes an important point in favor of planer

chips in stating that by their use the trouble from caked oxide is avoided. Certainly back pressure is reduced, and excessive heating of the mass is unusual.

MR. A. E. FORSTALL—I want to put in a good word myself for the planer chips. Although we have never coated them with oxide, we always keep a little stream of water playing on the chips as the material is being turned over for the first time, and I do not think very much of the oxide gets away. As for the increased revivification obtained by the use of raised grids, it has struck me several times when oxide has come out of the box very wet (as was the case when "wet" steam was used) that it would be a very good arrangement to put a set of trays a foot above the floor, and pass a steam coil under them to revive that oxide. As matter of fact I have seen batches of oxide that did not revive on the floor in ten months. It was only after we put the steam coils in our boxes that we could put those batches of oxide back and let the steam dry them out; and they have been used in that way this last winter quite successfully.

THE PRESIDENT—If there is no further discussion, Mr. Mather will reply to the questions which have been asked and close the discussion.

MR. MATHER—I would like to reply to the stricture that was passed on the name of my paper, by saying that I found myself in a difficulty, for when I was asked to write the paper it was my desire in doing so first to emphasize Mr. Forstall's very able paper by referring somewhat in detail to the mechanical working; but more especially to demonstrate the importance of chemical consideration and handling in this process.

As regards the sesqui-hydroxide I do not deny that the formula as given by Mr. Doty, and as given by Dr. Birchmore, is produced in the reaction mentioned, and that you do produce $\text{Fe}_2\text{O}_3, 3\text{H}_2\text{O}$; but the point I make (and I fear I still persist in making) is that once the oxide is dry and exposed to air or the ordinary action of purification, it loses two molecules of water and becomes $\text{Fe}_2\text{O}_3, \text{H}_2\text{O}$. Mr. Lewis T. Wright emphasizes the difficulty that he had in preparing this hydroxide chemically pure in getting his percentage of 17 to 30. He states that when he prepared his hydroxide, that even by repeated precipitations he produced free ammonium chloride; that he found enormous difficulty in getting

rid of this ammonium chloride. It had to be washed about fifty times, then dried, and then re-dissolved; and even then it was not pure. So, any attempt to compare purely laboratory practice with large working-scale methods is hardly advisable for this inquiry at least, because the results are not comparable. I merely have been trying to show what occurs in a general way in the box, and not all the reactions that may occur. There are two sulphides given, and there are undoubtedly other sulphides. There is undoubtedly a sulphide analogous to the pyrites formation that has been mentioned.

Mr. Miller's question, as to what depth the oxide should be filled, is difficult to answer. It is entirely a matter of condition. If your purification area is limited, and your "make" is increasing all the time, expose as much oxide as possible, because the slower the rate of passing the gas, the more complete and better will be the reaction between the sulphuretted hydrogen and the hydroxide.

In regard to the "blowing up" process, I may say that I merely alluded to that in passing. That is so much a matter of fixed opinion, as to whether you should blow up or blow down, or should combine the two as it is done in Chicago, and also in England, that mechanical convenience might well decide it; there is comparatively little choice, except as I have stated that the laboratory work proved, to myself at least, that blowing up is the better.

As to Mr. Miller's experience with dry revivification—that has been alluded to in detail before. The reaction between air and foul oxide takes place very rapidly when the oxide is dry—very rapidly, indeed. Water moderates that action. The theory of tray revivification is that you expose a great deal more surface than is usually exposed, and, besides that, you save the heat that is otherwise lost. Consequently the action of the whole will be more rapid than when piled up on the floor.

On motion of Mr. A. C. Humphreys the thanks of the Association were voted to Mr. Mather for his paper.

The Association then took a recess until 2:30 P. M.

The Association met at 2.30 P. M.

THE PRESIDENT—You will please come to order, and give your attention to the reading of Mr. Searle of his paper on "Gas Advertising."

(For paper see Appendix, page liv.)

THE PRESIDENT—You have heard a very good paper, and I believe it is one which will open the eyes of some of us to the possibilities of gas advertising. It is now open for discussion.

MR. E. G. PRATT—I have never heard before that Mr. Searle was the hero of three wars, but I do know that as an energetic gas man he is a "corker." We have heard from him before on just such lines as these, and the results of his work certainly emphasize what can be done in the direction of advertising. As he explains in his paper, there are a great many ways of advertising, and the question frequently occurs to us what is the best way. He has also referred to about every idea that it seems to me we can conceive of. As far as newspaper advertising is concerned, I may say that I have had some experience in that line. I think an ordinary Ad., say of two or three inches, in each of the local papers, and running regularly, is of very little account unless changed frequently. The eyes of the people are attracted to something new or unusual. If a steel plate Ad. appears in the paper it does not attract attention, and consequently ceases to become an Ad. I think that once a week, or once in two weeks, a large display Ad. in a newspaper—possibly taking one paper in the town at one time, and another at another, will result in much good. It has been my experience that a display Ad. calling attention to certain features, will bring good results. It has been customary with us for sometime to send out each month with our bills some sort of circular, calling attention to some particular feature of our business—either to stoves, burners, complaints of poor gas, or things of that nature. I certainly agree with Mr. Searle in the statement that he makes in respect to keeping burners and appliances of all kinds in order, and in condition for inspection at any time. It is remarkable the amount of money that most companies spend now, in comparison with former years, in keeping consumers good natured and in keeping ahead of complaints. In the city in which I am now located

we had some ten years ago but two or three complaint men, "meter and complaint men" as we designated them. That gang is now increased to eight or nine. It seems that there is nothing that can possibly be done that is not done for the benefit of the consumer, and in order to obtain and retain a consumer—to secure him and then hold him after we get him.

MR. W. FORSTALL—Of late years, several papers with nearly similar titles have been read before Gas Associations, but Mr. Searle, giving a very broad meaning to "Advertising," has covered all points of contact between company and consumers. There can be no question that such advertising always pays. We may ponder upon the relative merits of newspaper Ads compared with circulars delivered at front doors, of gas cooking on sidewalks as against cooking lectures at the Company's office, upon the general idea of whether Mahomet can be brought to the mountain easier than the mountain to Mahomet; but when in only five years, the meters increase 114 per cent., and the output is trebled, we recognize at once, that if this result had been obtained by advertising, that kind pays, and we are glad to hear how it was done. To me the paper is especially interesting, as our town of Lockport, N. Y., is of about the same size as Johnstown, and the two being not far apart, the local conditions and the human equations are probably quite similar. If Mr. Searle has set separate meters for stoves, he can tell us the increased output per lighting meter. This would be interesting as showing the effect of opening the capped-up outlets, by free distribution of brackets. Another question I would like to ask is, just what opposition, if any, was made to the Company's invading what, in most small towns, has hitherto been considered the exclusive domain of the plumber and gas fitter. In our attempts to advertise gas, we have piped completely several houses, in each case gaining a consumer who would have been scared off by his plumber's bid on the work, but who willingly paid us what the job actually cost. We think that the final result of all our efforts to popularize gas will be to give the plumbers more, rather than less work, but they do not quite agree, and are not as friendly as we would like. For many reasons we prefer to do this house piping and numerous small fitting jobs, instead of, say, hiring one plumbing firm to do all our work at a specially low rate; but there seems to be much feeling among labor union men (mostly not available as

new consumers, because poor, or not along our mains) in the matter of our cutting out the plumbers in this way; and I am desirous of finding out whether others are confronted with the apparent necessity of making enemies, while only trying to benefit their consumers, as well as themselves, in spreading the use of gas. Referring to the "den behind the holder," it is a very convenient place of refuge when special work is to be done, but there should always be a roomy office and show place on the main street; it is itself the very best advertisement. We are now paying \$600 yearly in this way, and although believing that work should end by daylight, we have found it advisable to keep open every Saturday evening during critical periods, such as early spring for ranges, and early fall for heaters. People are becoming accustomed to drop in, to see what of new there may be, and we are thus slowly educating them to think no longer of gas as an expensive source of light, but as an economy and convenience without which household cares would be greatly increased. Mr. Searle gives us two pictures, one of silver dollars with rudeness, the other of crisp treasury notes with urbanity. I know of a third, where we will say, with old school courtesy, a notice, printed on the bill and repeated on the sign that graced the den behind the holder, requested the consumer to "Be sure to bring the *exact* change."

MR. THOMPSON—In one of our cities we had rather a unique advertisement about two weeks ago. The manager of the company one morning found in his newspaper a half-page advertisement of a prominent clothing store, one-half of which was occupied by a cut of the store, and the balance by an advertisement reading in this way, and in full-face type: "Costs govern prices, and both are low. Here we have a daylight store illuminated by the Welsbach. Gas bill for last month only \$1.74." That was the first news that the manager had that such an advertisement was to be given his business. I was speaking of it to a gentleman who is a member of this Association, and he said that the clothing store man must have been level-headed or he would have known that the Gas Company, if it were not popular with the people, would be no credit to him as a reference in his own advertisement. A year or so ago, in the early fall, I noticed in Cincinnati a paragraph in the papers notifying consumers that at that season of the year difficulties from imperfect service were very apt to be appre-

hended, and asking the consumers on the first hint of any trouble with their pipes or burners to notify the company and everything would be put straight. A little verse came to my mind in connection with this subject of advertising:

“There was a man in our town,
And he was wondrous wise;
He swore by all the heathen gods
He ne’er would advertise.
But his goods *were* advertised ere long,
And thereby hangs a tale;
For the Ad was set in nonpareil,
And headed “Sheriff’s Sale.”

There is one point to which Mr. Searle called attention, upon which I would like to lay special emphasis; and that is as to the character of the employés of the company, and particularly that of the manager. To twist a popular proverb, which, in its application in this direction speaks abundantly for the popularity of the Johnstown company, “A company is known by the man it keeps.” (Applause.)

MR. C. J. R. HUMPHREYS—I do not know that I shall add anything to the value of this paper, but I am very glad to emphasize the point that the writer makes, which I take to be that the business, or the conduct of the business of the gas company should be, and is, a constant advertisement. I think there is a great deal in that. I think we are pretty well agreed that the time has gone by when a gas company can afford to have its office on the second floor, and have one or two stoves on exhibition, which are connected more or less imperfectly. I think we are all pretty well united on the point that we should have our offices on the main street of our city, and that we should show there everything that can be shown in the way of gas appliances, stoves and burners of all kinds. I think there is a great deal to be said on the point of the way our clerks act at the counters; and I think their conduct will always bear constant supervision—to see that a consumer goes away satisfied as far as it is possible for us to satisfy him. The subject naturally divides itself into two heads: The general advertising by the general conduct of the business, and the specific advertisement. We may or may not agree with the writer as to some things that he calls attention to. As to whether we should advertise the explosion of a gas stove is a point which I would hesitate

about. But there is one point that I think is worthy of comment. I have noticed in one or two places where gas companies do not handle the stoves or have anything to do with them, that the reputation of the gas stove is very poor; and that all kinds of stoves get out; there is no supervision of them; and the consequence is that they give a great deal of dissatisfaction and trouble. I think that an unsatisfactory stove is a very poor advertisement. One little trick we worked this summer was to get our advertisement on ordinary paper bags, and then get the grocers and others to use them throughout the city. We found that seemed to help us, as it brought the advertisement right into the kitchen, and sometimes on pretty hot days. I simply mention that as one little point. I am inclined to think if we could have a sort of Clearing House of advertisements, and if we could all know just what others are doing in this matter of advertisement, we would sell more gas than we do now.

MR. A. S. MILLER—As a scientific Association I think that there is one point we ought not to allow to pass without protest—and it is a point which I think Mr. Searle has probably overlooked. He says: "I think advertising could be safely classed among the sciences, and like all sciences, with study, one can soon master it." I think we had better raise a protest against that statement.

MR. C. H. PAGE, Jr.—This is a subject which I suppose you all know I am particularly interested in, as a great deal of my time is devoted to carrying out that end of our business. Mr. Searle has touched on the subject in such a broad way that I really do not know where to begin. There is one point, however, that occurs to me, and that is the matter of the personality of the manager. It strikes me that there has not been sufficient stress laid upon that. It is almost impossible to convince some people that by certain efforts, certain results can be expected, and for that reason some people will endeavor to be guided by the experience of others, and will fail, and will consequently think that the fault lies with the method. This last year we have made a little change in some of our advertising. Heretofore we have been employing a lady to go around from place to place, conducting what we call a cooking lecture. These lectures were ordinarily given in some hall, in as prominent a place as possible; sometimes in a theatre, sometimes

in the ordinary public hall. The latter part of this summer this was changed, and instead of a hall, we opened up a store and proceeded to carry on a demonstration of the work which could be done with gas stoves; the scheme was advertised very thoroughly in the newspapers, and also by circulars distributed about the city. The advertisements and circulars stated that on certain days and at certain hours special dishes would be prepared, and that at certain hours the lady in charge would be ready to answer questions, and to prepare special dishes upon request. We found that in a town of 30,000 population, the daily attendance would frequently be as high as 250 or 300—people who would just drop in to see how the work was done, to ask questions, and to get corresponding explanations. I think that has demonstrated that there will be no more cooking lectures under the old plan. This last year the gasoline people have been active in carrying on demonstrations of a similar nature; but I do not think that they made the success that we did. They have, of course, some attendance, but as far as I have been able to gather, they have not sold their goods very extensively. At the same time, it is a method of doing business which I think can be tried by everybody with success.

MR. PINKNEY—Mr. Searle has, unconsciously, I presume, reflected somewhat upon the average cashier of gas companies, more especially those in the smaller places, where the bulk of the money is taken in on the last discount day. The average cashier is, on that day, usually burdened with about all that he can attend to, and if he should perhaps inadvertently speak a little cross, or if he should not, to a consumer, but refer him to the complaint clerk window, I think it would be eminently proper for him so to do. It would be no time, nor place, for him to discuss complaints, surrounded by so many, and he could not discharge his duties and get rid of all the consumers in the office before closing time, if he did not do so. Referring to the paying of bills through a "hole in the wall," of course, Mr. Searle was speaking figuratively, and I am not criticising him in any way, but the factor of safety demands that the cashier of a gas company shall be surrounded by some safeguards; otherwise it would be a very easy matter to reach over the counter on a day of that character, and secure enough money to make the gas company poor; otherwise I am heartily in favor of

Mr. Searle's paper, except that I entirely agree with Mr. Humphreys in his statement that if I had an exploded gas stove anywhere in the city, I would confine knowledge of it, if I could; I would not advertise the fact. I have repaired them, however, free of expense.

MR. McDONALD—Mr. Page has mentioned the personality of the gentleman who has charge of the works. As I believe very thoroughly that personality is a matter of education, and which anyone can cultivate, I rise to relate a little incident regarding Mr. Searle and his methods. As you are all aware, I live at Albany, and often go to New York. Going down one evening on the train, sitting in the smoking apartment of the car, I met a couple of apparently very intelligent gentlemen who were merchants in Johnstown. After a little conversation I said to these gentlemen: "I only know one man in your town." "Who is that?" I replied, "Mr. Searle." "What? Searle, the gentleman who runs the gas company?" "Yes," I said. "Well, he is a dandy." (Applause.) "If all the gas companies had men like Mr. Searle to run their plants, they would get consumers." Then he went on to relate a little incident about some trouble that had occurred in his factory, and said that he had had three or four gas fitters there attempting to remedy it; but finally he sent for Mr. Searle. He came in a few moments, ascertained just what the trouble was, sent some one right away to remedy it, and made everything plain sailing. I do think it should be the endeavor of every gas manager to make his personality felt by the consumers.

MR. LITTLEHALES—I would like to call the attention of the Association to another phase of advertising, the possibilities of which have been overlooked, even among the numerous ones that Mr. Searle has mentioned. In canvassing in the spring for gas ranges, we take the precaution to get the information as to whether the houses were piped, and if piped, whether there are any fixtures there or not; because the spring is a poor time to introduce the lighting business, summer is coming on, and they generally wish to wait until fall before putting in a new lighting system. But during the spring, while we are canvassing for gas ranges, we get the information about the lighting. We keep this information, and when the rush of business is over with gas ranges in the fall, we take up these lists of houses piped, but having no fixtures. We have a little

arrangement which we take around, which some people call the gas company's barrel organ; it is simply a little hand cart which is fixed up with three sets of fixtures—for two lights, three lights, four lights, and kitchen fixtures, brackets, etc., and these are covered over with an oilcloth, to keep the dust off. Two men, our canvassers, take one street, a boy pulling the truck along; and in many cases they have previously had an intimation of people who were considering the question of putting in fixtures; these are tackled first. As soon as they find a person who is favorably disposed, they uncover their truck, open up and show what they have got as their traveling samples. There are different fixtures on the cart, and they can be easily unscrewed, and if a person is disposed towards buying, they unscrew a chandelier, carry it into the house, hold it up, and show how it will look inside of the room. We have been doing that now for about five weeks, and the result has been a sale on an average of from \$75 to \$80 worth of fixtures each week; sometimes it is as high as \$112, and we gain an average of five to seven new consumers each week as the result of that. We have found that a very effective method of advertising. We are also running a cooking school of the kind of which Mr. Searle has spoken. Last year we gave three lessons per week; this year there are six lessons per week, and all the classes are filled.

MR. C. H. PAGE, JR.—There is one point that I would like to speak of in connection with the use of cooking schools instead of lectures, and that is that where there are lectures they are generally carried on up-stairs, and you are liable to get one class of people, and only one, attending at a time; whereas on the street you get everybody. I think that is a very important matter.

MR. A. C. HUMPHREYS—I simply want to emphasize a point which has been particularly referred to by Mr McDonald, as to the personality of a man, and as to how he impresses that personality upon his consumers. You cannot always trust your subordinates to constantly maintain a proper attitude toward consumers. That may be unfortunate, but in my experience that is the fact. I think, therefore, that not only must the manager be capable of meeting his consumers properly, but he must keep constantly in mind the necessity for his doing so. Of course in a very large company it may be an impossibility for him to do all the demands

in that particular direction, but he certainly can do some of it, or if he has to delegate it, it must be delegated to a man who is eminently qualified in that particular line. I do not believe any gas company can be successful in its treatment of this branch of the business—and on this all depends, for there is no use of making gas if you cannot sell it; and there is no good in making it cheaply if you cannot sell it—I do not believe a gas company can be successful in its business unless it has someone, whether principal or subordinate, who comes constantly in contact with the people, and who is peculiarly qualified for this particular class of work.

MR. SHERMAN—I agree with all that has been said in regard to Mr. Searle's paper. He has stated self-evident truths. In the management of the sales department business talent of high order should be employed and paid as liberally as the head of the manufacturing department. It is an equally important department. In the early days of our business it was very much injured by the treatment which customers have received from our clerks. It can't be insisted on too strenuously that our customers must have civil and courteous treatment from our clerks and employés. If we wish to sell our gas we must carry on the business on commercial principles, as has been so well stated in Mr. Searle's paper.

MR. NEAL—I could take up all the afternoon in relating my experience in connection with the sale of gas stoves and putting them up for our consumers, but time will not allow. I will simply say, with reference to the methods of advertising, that I advertise in one Charlestown and in two Somerville papers; and I instruct those who make up the advertisements to change them frequently and to make them as interesting as possible; to make pretty broad statements, and I find that that works very well.

MR. JENKINS—During the last month I have been thinking very seriously that we are neglecting one mode of advertising. During this summer I think not a week passed when there were not at least two deaths, and in some cases most horrible ones, which occurred in Cincinnati and vicinity from the explosion of gasoline stoves. I think that there is material there for advertising by telling the public what has happened—not only once, twice, but at all times; and if we could collect any kind of data which these acci-

dents would give us, it would almost keep people from buying such dangerous articles. Last Saturday night in the city of Covington a woman with two little children were in a room when a gasoline stove blew up, and she was covered with gasoline from head to foot. She attempted to get out of doors, the door closed behind her, and left her standing on the veranda outside, and there, in the view of a hundred people who had congregated on the street, she burned to death, a living torch. That is only one case. I believe that Mr. Miller will bear me out in the statement that at least two deaths and sometimes more have occurred in that vicinity every week this summer. I think it would be well for us occasionally to take those up, by circular or otherwise, giving simply the data, the date, the location of the accident, etc.

MR. ROPER—I will give you some figures about the gasoline business which I think will be of interest, and which will show you that it will take care of itself. These figures are taken from the report made to the National Association of Stove Men, including coal and wood stoves. I may say that they send out a circular asking you to give certain information, and return to them the replies; you need not sign it, because they will know where it comes from by the number on it. We received one of those circulars, but we were not in the gasoline business and we refused to send them any statement whatever with regard to the gas stove business. They report a falling off in the gas stove business in 1896 as compared with 1895 of 34 per cent; a falling off in the business in steel ranges during the same time was 56 per cent.; and the falling off in the gasoline stove business during the same time was 84 per cent. That is from their own Association. Therefore I do not think we need worry about the gasoline business.

THE PRESIDENT—As this will be made a matter of record, would it not be well for you to state your impression as to the correctness of the first figure given?

MR. ROPER—I cannot say anything except so far as I am myself personally concerned. They sent us their circular, but we refused to mail it back to them (except in blank, as they furnished a stamped envelope), and gave them no report of our own business. But I may say that our business during that same period

increased 52 per cent. If the same is true of others, that 34 per cent. falling off in the gas stove business could be easily wiped out.

MR. PINKNEY—Is there a man in the room who can conscientiously report a loss of sales of gas stoves between 1895 and 1896?

THE PRESIDENT—If so, will they stand up and be counted? I think that almost every one in the room would report an increase. A year ago I sent letters to all the gas stove manufacturers in the country (in connection with a paper which I read at St. Louis) and all who answered reported as Mr. Roper states with regard to his own business, an increase as compared with the year before.

MR. ROPER—I was simply giving the figures as they were given to me by a member of the other Association; and I suppose naturally that if the gasoline business fell off 84 per cent. and the steel range business 56 per cent. they would like to make the gas stove business fall off a little.

MR. SOMERVILLE—I just want to remind the members that the President in his address yesterday gave us what is to my mind one of the most effective advertisements I have ever listened to; namely, when he stated that the enormous increase of consumption in London was chiefly owing to the fact that the companies there were putting in gas stoves and fittings and plain fixtures free of charge, and recouping themselves for doing so by charging a little more for the gas sold. It struck me that that is something we will yet have to do here, and that a great field is here lying unexplored.

THE PRESIDENT—If there is no further discussion Mr. Searle will reply and close the discussion.

MR. SEARLE—In replying to Mr. Forstall, with regard to the opposition of plumbers, I may say that the ratio of opposition is: Coal men, 25; oil men, 8; stove men, 23, and fitters, 8. That is, there are seven times as many antagonized in other branches of business than among fitters. However that may be, I made the point that we have done such work there, and have got the people so enthused that the plumbers did more work than ever. I might

say that we bought the stuff in such large quantities and sold it to them at cost to us and then they sold it at a profit; so that really the feeling towards us with all plumbers was thoroughly mutual; so much so that they gave us credit for increasing the trade and getting them business which they could not have controlled. Whenever it costs \$15 to \$18 to equip a small cottage, they would send it to us, knowing that they could get nothing from it; but if it was a large church, where there was any money in it, we invariably threw it into their hands.

As to the increase in consumption per meter, I will say that we once made a proposition to a consumer who had estimated the annual consumption of gas at 5000 feet for a gas stove, where the meter already existed on the gas stove, but no winter consumption, and found that we figured out an annual consumption of 12,000 instead of 5000 feet.

I stated these things a long time ago, and at first had to go rather slow. I never figure on a basis of less than 1000 fixtures or meters; and I look at that as a pretty good increase; and in nearly every case, the figure given as the original earnings has been exceeded by nearly 200%.

In referring to the advertising of explosions of gas stoves, I spoke of that in recollection of a gas stove explosion which occurred at a church in which they were holding an entertainment; somebody fooled with the oven and it "went off," but fortunately nobody was hurt. I went to the church as soon as I heard of it, and made an impromptu speech to the ladies present, and tried to impress upon them the fact that, whereas the gas stove injured no one by its explosion, if it had been an oil stove every one of them would have been burned to death. As a matter of fact every window in the room was broken, and the glass fell on the *inside* of the room (which was a phenomenon to me); and a woman standing near the stove was nearly made deaf; it was a week before she could hear again, but she is using a gas stove still.

Replying to Mr. Pinkney's suggestion that the cashier has too much to do, on the discount day in receiving money, to attend to the complaints of the consumers, I answer that there are many people who never go into the Gas Company's office, except when they go there to pay bills; and that is the best and sometimes the only opportunity to make them your friends.

As to clerks getting cross; I instruct them all very carefully, and endeavor to keep them all in touch with the interest of the company; and always advise them when they feel cross that it is better to take a walk around the block, and ease their feelings that way, than to take a slap at a consumer; or, if they do not feel that they can treat a man courteously, to let him go, and I will handle the matter; that if they have anything to take out of any man, they had better take it out of me.

Mr. Littlehales speaks of sending fixtures out to possible consumers. We had a plan in Johnstown of sending a man, even where we knew there was only a trivial complaint, to exhibit a fixture in the place while attending to the complaint, and very likely the woman of the house will ask, "Where is that going?" Our man would answer, "That is going off to Mr. So-and-so's house; but you ought to have one of those."

It has been suggested that it takes a good while to teach the employees when to make a proper reference of a complaint to the officers; but you would be surprised at the amount of information the men get, even when working in the ditch. If a man observes readily and is really bright, he is out of place in the ditch; but you can educate any man after a while when to make a proper reference to a higher authority, so that a sale can be made or a question answered, and the thing disposed of.

As illustrating Mr. Sherman's remark about the incivility of employees in the early days, I may mention a scene in a gas office when a lady came in and asked about the cost of gas stoves, and the clerk threw a catalogue at her, and went on talking to some one else, allowing the prospective purchaser to take care of herself.

On motion of Mr. A. C. Humphreys, the thanks of the Association were voted to Mr. Searle for his paper.

THE PRESIDENT.—Mr. Littlehales has a short topic on testing meters. Will you please give your attention to him?

SOME FACTS AND FIGURES ON THE TESTING OF CONSUMERS' METERS.

The data that I have the honor to place before the Association, while it does not rise to the dignity of a paper, is nevertheless accurate and reliable and will, it is hoped, be found useful, especially to the younger members, who have not had opportunities to acquire such information for themselves.

When I took charge of the Syracuse Gas Works (to follow my esteemed friend Mr. Austin G. Wood), among other things, it was decided to have the whole of the consumers' meters tested and overhauled, which work is now well advanced, and the facts here submitted are up to the 23d September, 1897, and on a total of 5,427 meters already tested. The record is as follows:

SYRACUSE (N. Y.) GAS COMPANY.

RECORD OF METER TESTING.

Percentage of Error.	FAST.		SLOW.	
	No. Meters.	Pts. Fast.	No. Meters.	Pts. Slow.
1	538	538	687	687
2	559	1118	697	1394
3	277	731	419	1257
4	157	628	392	1568
5	105	525	182	900
6	56	336	297	1782
7	21	147	74	518
8	7	56	87	696
9	4	36	51	459
10	10	100	48	480
11	1	11	11	121
12	5	60	28	336
13	2	26	6	78
14	1	14	6	84
15			14	210
16			5	80
17			5	85
18	1	18	6	108
19			3	57
20			5	100
22			3	66
24			1	24
25			5	125
26			1	26
30			1	30
32			1	32
	1744	4344	3035	11303

Total number of meters tested Sept. 23, 1897.....	5,427
Meters fast, as per previous table.....	1,744
“ slow, as per previous table.....	3,035
“ correct (less than 1% variation).....	616
“ not registering.....	31
“ not passing gas.....	1
	5,427

Total number of points slow.....	11,303
Total number of points fast.....	4,344

Total error equal.....	6,959 points slow.
Equal (on 4779 meters in error).....	1.44% slow.

There is one point in the foregoing record to which I wish to call special attention, that is in reference to the comparatively few meters that ran over 7% fast; only thirty-one in all. And I might say, that in my previous thirty years' experience I have scarcely ever met with a meter over 8% fast; while there has been no limit to the percentage of error on the slow side; consequently I gave special personal attention to the cause of this variation from my previous experience. The trouble is in the diaphragms; whether the cause be insufficient care in the selection of the skins or, as has been explained to the writer by one maker, "Their desire to produce a meter that would work with the least possible pressure, carried them too far in the use of light leathers"—the fact is that the trouble is caused by too thin skins, and where this defect is found, it is invariably in meters of the larger sizes; 10 light, 20 light and upwards; the upper portion of the diaphragm collapses, and doubles inwards, preventing the full inflation which should take place, and this reduces the capacity of the diaphragm. While it may be presumed that all the meter makers are now aware of this fact, and those makers in whose products the weakness is found have corrected the defect in the meters now being put out; yet, as there are a great many of these defective meters, made in past years, still in operation, it should make it all the more incumbent on the gas manager to keep a watchful eye on these old meters, although it is only just and right to say that the products of some meter factories are almost entirely free from this defect.

Some years ago Gen. Hickenlooper gave us the benefit of valuable data on this subject, which has constantly been used as a text, and deservedly so.

As the meter is the arbiter between the gas companies and its customers, and is wholly under the control and supervision of the gas company, it is an imperative duty to have every meter in such shape that we can with the greatest confidence bring one in and set it on the tester, in the presence of the consumer, feeling sure that it will come out as nearly as possible to correctness every time; and to establish in the mind of the consumer, and to be able to maintain beyond a doubt or question what every gas man knows to be a fact, that there is no piece of machinery in existence that has had the rough usage, and on which so much depends, that can be more thoroughly relied upon for general accuracy than the much maligned gas meter; and notwithstanding the fact that errors do occur, and meters are occasionally found defective, where the errors exist they are much more in favor of the consumer than of the gas company.

I will show you the diaphragm I speak of, indicating where this trouble exists. I do not think it will be found in the meters now made, but it is found in the old make of meters. *This* is the diaphragm I referred to. It doubled up in the shape you see it—collapsing and then doubling inwards—instead of the leather being like *that*, it had collapsed and taken in a portion of the chamber. I found that tendency in a large number of meters with thin skins.

MR. SEARLE—Did I understand Mr. Littlehales to say that the average error in all of them was about 1 per cent.?

MR. LITTLEHALES—No; the total difference, as it affected the company, was 1.44 per cent. slow. Deducting the meters that were fast from the meters that were slow, and dividing that difference by the whole number of meters in error, it gave a loss to the company of 1.44 per cent.

MR. SEARLE—You made a reference to unaccounted-for gas. Did I understand you to mean that this did not affect the unaccounted-for gas as much as one would think?

MR. LITTLEHALES—Yes.

MR. SEARLE—My point is that if we had two meters, one passing 100,000 cubic feet, which was 50 per cent. slow, and the other

passing 5,000 cubic feet, which was 1 per cent. slow, you would have considerable more loss on account of unaccounted-for gas due to the meter.

MR. LITTLEHALES—I am speaking now of the total number of points shown to be fast, and I am simply taking the records of the number of meters fast and the number of meters slow.

MR. SEARLE—I understood it was on the line of giving up looking to the meters for unaccounted-for gas. It would make a considerable difference.

MR. LITTLEHALES—When dealing with unaccounted-for gas there are four principal causes to be accounted for: Mains, services, meters, and condensations. A certain amount belongs to each. The result of my experience shows that so far as the meters are concerned it means on that record that we are losing 1.44 per cent; because while some were slow and others were fast, giving the account credit for the fast meters reduced the error for slow meters to 1.44 per cent.

MR. THOMPSON—This discussion is one in which I am very much interested; and I would like to ask if Mr. Littlehales, when this paper is printed in our proceedings, will not prepare a supplement to that table, figuring the loss in one light meters of the percentage slow. That was the suggestion made by Mr. Addicks in 1891. He makes the basis on the size of meters as well as on the percentage of error.

MR. LITTLEHALES—I do not quite see the bearing of your question.

MR. THOMPSON—It is this: If, as Mr. Searle says, your slow meters are among the large ones and your fast meters are among the small ones, the effect upon the company in the loss due to incorrect registration will be very much different from the mere average of percentages of the meters. In other words, an average of averages is not an average.

MR. JENKINS—I would suggest that the best way would be to get the consumption of each of those consumers for a year, and then you will be getting right down to business. You may put a 30-light meter in, and it may be in use only two months of the year; or you may have a 5-light meter run for a whole year. To

get down to business you should take the actual use of all the meters for a year.

MR. SOMERVILLE—As Mr. Littlehales has stated, the greatest trouble is due to the collapse of diaphragms in large meters especially; and I think it would be a good thing if meter makers would put in a wire to keep the diaphragm from doing that thing in small meters. I would direct their attention to that, because the greatest annoyance I have had has been caused by the collapse of the diaphragm increasing the falseness of the meter.

MR. LITTLEHALES—I would like to make that point clearer. I do not believe that any meters are made to-day which suffer from that defect. What I referred to is the fact that there are in use many meters which were made in the past, and which are slow, and need watchful care and looking after. I think that the meters made to-day are free from that defect.

On motion of Mr. Beal the thanks of the Association were voted to Mr. Littlehales for his paper.

THE PRESIDENT—You will now give your attention to Mr. A. S. Miller, who will read his paper entitled “Some Further Experiments on Interior Illumination.”

(For paper see appendix page xiii.)

THE PRESIDENT—We have before us a very interesting paper, and one which is the result of a great many careful experiments. It is before you for discussion.

MR. C. H. PAGE, JR.—I have read Mr. Miller's paper very carefully, and am gratified to find that notwithstanding his remarks at our meeting last year, that I had apparently proved that white paper was not white, he practically substantiates by his experiments what I endeavored to show, namely, that illuminating effects are not ordinarily measured by the photometer.

In the second paragraph of his paper, Mr. Miller states that the method I employed “introduced an error, the gravity of which could not be estimated.” From my experience in my original investigations I hope Mr. Miller provided his apparatus with some adjustment for determining the actual angle at which the reflecting screens were placed with certainty, else I would be inclined to question the comparative results, for I found that a small deviation

from a given angle produced a remarkable variation in the results obtained. It was partially for this reason that I abandoned the single reflecting surface.

The principal reason for adopting the box method was to approximate as closely as possible the conditions actually existing in an apartment. I think Mr. Miller's paper would have been more justly termed "Some Experiments on Surface Reflection," for there are no conditions approximating an interior in his researches.

I wish to call attention to the experiments with paper No. 1. That is that the stiff flame of a No. 7 Bray special union does not give as much reflected light as the flabby flame of the same burner, with, I presume, the same quantity of gas. The same result is shown in paper No. 2, when a No. 3 Bray and a No. 7 Bray are compared. Paper No. 3 shows the same result. Paper No. 4, which is a piece off the same roll I used last year, and which Mr. Miller said I only proved was not white, gives the same reflected value for the No. 3, and the No. 7 Bray, but gives a lower reflected value when a No. 7 Bray is compared with a Welsbach lamp than any of the other samples.

I would like Mr. Miller to explain why, in view of the above results the reflected efficiency of the No. 7 and the No. 3 Bray burners is identical in this case; but that of the Welsbach is less by 4.7 per cent than any of the other papers.

I feel that both Mr. Miller and Mr. Humphreys have misunderstood the drift of my experiments last year. I certainly did not claim that an opal globe would increase the light transmitted from any source. I proposed to show that illuminating effect was largely dependent upon the color and the size of source of light. This I believe has not been proved false by Mr. Miller's experiments.

The bar photometer is beyond a doubt the only correct way of measuring candle power; but I am sure it does not measure illuminating effect, inasmuch as I have shown by my experiments, and Mr. Miller has apparently substantiated my results that more light is reflected with a flabby flame than with a stiff flame of the same candle power.

MR. A. C. HUMPHREYS—I did not expect to take part in this discussion, as I have not had a chance to make a study of this paper, and it is one that needs study. I was going to ask Mr. Miller to develop the paper a little more in the discussion, so that

we could take in its full bearing to better advantage; but no doubt Mr. Page has taken care of that point now.

As I understand it, Mr. Miller has been taking a different colored flame and different colored papers to try and show us the different effects to be obtained by the direct light and the reflected light, and also the effect of putting on an oval globe, as following the lines previously pursued by Mr. Page. I think that while the net result might not have been different, perhaps the extra care required would have been paid for, if more care in the first place had been taken to start off the experiments with absolutely equal illuminations on the bar whereon the lights were measured directly. It would have made the comparisons simpler, and I think that such an arrangement could have been obtained without any great extra trouble. I possibly may have misunderstood the points that Mr. Page was aiming for in his paper, but I do not think I did. I have never contended, I believe, that we could measure *illuminating effect* by a bar photometer; but I have contended that the bar photometer was the most accurate instrument we had at present for leading up to such measurements, or rather estimates; and that we were forced into the position of measuring the lights directly so as to eliminate these very errors which must of necessity creep in (and not only errors, but limiting conditions) and then finally that we must read our results in view of the surrounding conditions. Of course, when Mr. Miller starts in with two lights of different color, and a reflecting surface of color, we have got to bear in mind what the positions of those two lights are, and what will be the effect upon each of those lights in the way of absorption before reflection. I have always contended that it is impossible to think of that in connection with practical illumination, because the light which would be the most economical and the most efficient for one room, would be, perhaps, the light least efficient in the room adjoining, and this because of the variation in color in decorations in the same house. And I confess I am unable to see any way in which we can value our illuminants for light-giving purposes except through a photometer, and then read the results to the best of our ability beyond the actual readings.

MR. A. E. FORSTALL—I read this paper when I first received it, and intended to say something on the subject, but since then I have been so busy that I have not had time to give it any thought.

I do not know that it is exactly pertinent to this particular paper, but as this is a continuation of a subject which has been before the Association several times, I might speak of a point which occurred to me during the previous discussions. In all the discussion about the diffusion of different lights we lose sight of the fact that in most cases the apparent difference in illumination of a room with a soft light and with a bright light is merely due to the fact that it is very hard to avoid bringing the eye in contact with the direct rays from the bright light, and getting it accustomed to that amount of brightness, so that as the eye turns to the rest of the room it seems darker, when it is really much more brilliantly illuminated (and would so appear, if the eye had not been incapacitated from taking in the illumination) than it is in the case of the softer light, when we think that we have more light. I think when we keep in mind that point of view, all difficulty in the way of diffusion between bright lights and soft lights in the ordinary atmosphere of a room will disappear. If we screen the bright light, even if we cut off some of the light, we may apparently have a better illumination; but it is simply apparent, not actual. It is merely that, un-screened, the light deadens the retina and we do not take in the effect upon other parts of the room when we turn away from it, it being impossible to keep the eye from being affected by the greater brightness.

THE PRESIDENT—If there are no further remarks, Mr. Miller will close the discussion.

MR. A. S. MILLER—I will say that in starting out with these experiments, I intended to make a great many more. In fact, I had laid out to do a great deal of work on them this summer, but unfortunately was taken sick, and lost a great deal of time from the office; and it was therefore necessary to draw conclusions from comparatively few experiments. In working with these very small quantities of light, it was impossible to stay in the photometer room more than an hour or so before the eye would become very tired, and it would be necessary to give up work for that day. Also, it was very hard to get an hour on a large number of days. I started out with the idea (which would seem very logical) that the tinted lights would be reflected more by the tinted papers than the white light would be by the tinted papers. One or two of the experiments do not seem to bear that out; but there must have been an

error in estimating either the tints of the lights or the tints of the papers, or else in making the readings. This would partially apply to the last point which Mr. Page made. He stated that a larger proportion of light was reflected from the lights which were covered by the opal globe than was reflected by lights which were not so covered. I think that of the light which passes through an opal globe more would probably approach the tint of the paper which was used, than of the light which did not so pass. Passing a white light through an opal globe would, I think, tend to tint it yellowish, so that from a yellowish paper more of it would be reflected than would be reflected from an unscreened light. Every care was taken to get the proper angle of the screens. In the first place the stand for the screens was carefully made; then a circle was laid out and carefully divided in the drawing office; and then a blue print was made of this circle. These blue prints were verified after they had been washed and dried, to see that they had not shrunk or changed. The angles were laid off on the photometer, and these circles were pasted to the table. Pointers were fastened to the bottom of the supports for the screens, which, as I stated in my paper, could be revolved around a vertical axis. These screens were tested in a number of positions, not holding one screen still and moving another, but revolving both screens at the same time, through the same angle, in order to see whether some lights would be better reflected at one angle than they would be at another. As the surface of the paper was very dead, there was a comparatively small difference in the light reflected when angles of incidence and reflection were the same from what it was when the angle was made a little greater or a little less. I think that the angle of the screens could almost be calculated by reading the bar, provided one screen was still and the other was turned. Regarding Mr. Humphreys' suggestion about making the lights equal, I will say that it is a thing that it is very hard to do, especially when a Welsbach light giving forty candles is compared with a light that we try to keep flabby and yellow. I might have been able to have done it by getting some of those very large burners; but, as I have stated, I did this work in a comparative rush (which I was very sorry to have to do) and did not have those burners at hand. Mr. Page made a point that I did not get exactly. Perhaps he will remember it. I did not follow him as he spoke. It was somewhere about the middle of his paper. It was between the questions about the angle of the

screens and the amount of reflected light due to the globes. I would like to have him state it again. It was with reference to some results that I got, which he did not seem to think well of.

MR. C. H. PAGE, Jr.—Shall I repeat?

MR. A. S. MILLER—Yes; if you please.

MR. C. H. PAGE, Jr.—You misunderstood my question. I think it was this: I would like Mr. Miller to explain why, in view of the above results (that is, that when paper No. 4 gave the same reflected light for the No. 3 and the No. 7 Bray, and it gave the lowest reflected value when the No. 7 Bray was compared with the Welsbach lamp) the reflected efficiency of the No. 7 and the No. 3 Bray burners is identical, while the Welsbach has less by 4.7 per cent. than any of the other papers. Does that sound like the question?

MR. A. S. MILLER—Yes. I should say that it was because the paper was well adapted to reflect the lights from No. 3 and No. 7. That is, the tint of the paper was approximately the same as the tint of the lights; and the Welsbach was whiter than the other lights, while the paper was not so white.

MR. SEARLE—Have you any reason to believe that different colored reflected lights (not in photometer practice, but in your experiments) had any effect upon the light upon each side of the disc in making the star appear? That is, as to the action of the eye.

MR. A. S. MILLER—I reply to that by saying that I used a chalk disc. I experimented with a Leeson disc, and then I used chalk drawn to a very acute angle. I do not believe that the color was sufficient to make any serious difference. The amount of light handled was very small (as you can readily understand, it being the amount of light reflected by a 12-inch disc from a burner of 20 or 40 candle power, as the case might be) and it is impossible to say just what effect there was. I had two or three of my assistants come in and take readings to see if our eyes were approximately alike. The placing of the screen seemed to be near enough in every case to show that the error was reasonable. Of course, it is impossible to say that there might not have been something in the tints that could have affected all of our eyes in the same way; nevertheless, I feel that an error of that kind, or due to that, was

not very great. Also, to avoid errors, in every test I changed the discs around, so that in case of two samples of the same paper not being identical, the error would be eliminated. I reversed the screen in the photometer, and made every check that I reasonably could; but I could not read from both sides of the bar, because there were two bars, and I could not get between them; but I took every precaution that I possibly could.

MR. SEARLE—Have you made experiments showing, or have you reason to believe that if the light did vary on the disc it would be reflected on the photographic film (if photographed) so that two photographs when compared, after development, would show up alongside of each other the difference in the color of the light? Have you had enough experience in photography, as well as in photometry, to demonstrate that?

MR. A. S. MILLER—I have had no practice in photography, and I would not like to say how it affected the actinic quality of the light to be reflected. That is something that I did not go into, but I think that might very easily be determined by putting a sensitive plate in the room.

MR. SEARLE—If that was determined, do you not think that it would settle the question of Candle Power *vs.* Illumination?

MR. A. S. MILLER—I do not think so. I think the chances are that a very large proportion of the actinic rays are absorbed by a surface of this kind, and probably only a very small proportion are reflected. I think you will find that at the ends of the spectrum towards which the actinic rays (the violet rays) are, the light is very much more refrangible, and that it will be absorbed by an opal globe or reflecting surface, and that less of it will be reflected or transmitted. You may take a bright day, and a cloudy day, and although there might not be very much difference in the light in any particular spot not actually in the sun, on those two days, yet you will find a very great difference in the actinic rays at those points; thus showing that although the light which affects the eye is largely the same, yet the actinic rays have very largely been screened out on the cloudy day; they are very much more refrangible, and are very much more easily lost in going through the same translucent objects and in being reflected.

On motion of Mr. Beal, the thanks of the Association were voted to Mr. Miller for his paper.

THE QUESTION BOX.

THE PRESIDENT—We have a few questions not yet answered, and which the Secretary will read.

Question: “Is it advantageous or beneficial for gas companies to encourage the lighting of streets with self-generators of naphtha burners beyond their mains?”

MR. A. S. MILLER—A case came up in connection with that some years ago in a company with which I am now connected. The city wanted a proposition for lighting all the streets, and it was necessary to light the streets not only on the mains, but beyond the mains. A contract was made with one of the lighting companies (a naphtha company) by which they would light such territory as the gas company desired, and then as the gas mains were extended that business was to be turned over to the gas company. In that way the gas company was able to hold a very large territory which they would have eventually lost if they had allowed it to go to a company not under their own control. As a rule the tendency of the electric lighting companies has been, until very recently, to go into street lighting; but I now hope that they have reached their maximum and that the tide is turning. I think by all means that the gas companies should control all of the street lighting as far as possible; and they can very easily control that lighting by using some form of vapor or naphtha lamps. I do not think that form of lamp lighting is likely to compete with gas lighting in any way; and I think we should encourage them in order that we may keep the business approximately under our own control.

MR. A. C. HUMPHREYS—I would like to give my testimony in the same direction as Mr. Miller. I have had a great deal of experience in a number of places where we have found it advantageous to make a combination of this character. Of course the gas company has got to protect itself and provide that the arrangement shall be for their ultimate benefit. But I think in connection with vapor lights and naphtha lights we have in the Welsbach something that will better show to our advantage. Of course we have lost a great deal of street lighting, and it seems to me we now stand a chance of getting a good deal of it back through the Welsbach street lighting system. If this is true then certainly it will

apply to vapor lights, because the same argument that Mr. Miller refers to as helping to hold the flat flame burner will still better apply to the newer and better Welsbach lights for street lighting. I feel that we have a wonderful opportunity here to regain some of our lost ground in the streets if we only follow it up to the best advantage, and especially if we can only co-operate in the right way and for our own protection with the people who have the matter in charge.

THE PRESIDENT—There is more in this question than appears on the surface. A number of instances have turned up over the country where the gas companies have thought they were not being treated fairly. It means so much to us, as the last two gentlemen have stated, whether we can or cannot get back street lighting, that it seems to me that it would be but fair, and also for our interest as well, to call on Mr. Prendergast, a representative of the Welsbach Street Lighting Company of America, for a statement of the purposes of that company.

MR. D. J. PRENDERGAST—No doubt, as the gentleman has just stated, you are familiar with the methods pursued by the old legally chartered and capitalized naphtha street lighting companies. They have been in existence in your territories for the last twenty years. You know also their methods of doing business, and that it is not their purpose to interfere with or compete where gas mains exist. No doubt you have had your troubles with individuals who have undertaken to do this kind of business, and with overnight companies which possibly had their eyes on the street lighting. The recent improvement, referred to by Mr. Humphreys, namely, the incandescent Welsbach light, is controlled by the same people who have pursued this business for the past twenty years. It is their purpose to use it in connection with their gas appliances, and to enable gas companies to submit propositions to municipalities for the entire lighting of cities with a uniform light. That means to give a light in competition with the old competitor, electricity—a 60-candle power light to be placed wherever desired. It is not the purpose of the company that I represent to use naphtha where there is a gas main. It is their purpose, as stated by Mr. Miller, and as pursued by them with the old naphtha lights, to make a contract with the condition that when the mains are extended the naphtha light is to be replaced by the gas light. No doubt there

are times when the agents employed by a company will become enthusiastic, and may make some statements which they are not authorized to make. While here as the representative of that company I will request any gas company, upon whom our agents do not call when they first visit the city to get the condition of affairs, and to co-operate with the gas companies for securing what street lighting there is in the city, to report the matter to our principal office in Philadelphia, it will receive immediate attention from the President, and I am sure that any complaint will receive due consideration.

I have not prepared anything to say, and so I may have overlooked something that might be of interest to some of the members of the Association, but I will be only too happy to answer any question asked by any member present regarding our methods of operating this business. I probably might state, before you ask any questions, what propositions will be received. We will entertain any reasonable business proposition from a gas company to enter into competition with electricity for the purpose of lighting the streets of their city. That is to say, we will rent our fixtures, we will buy gas from them, and do the repairing, and furnish appliances; or we will divide it up. We will entertain any reasonable business proposition. That is my instruction, and that is the purpose of the company.

If there is any further information desired, or any question that any gentleman would like to ask, I shall be only too happy to answer.

THE PRESIDENT—Does any member wish to ask any question of Mr. Prendergast, or does any other gentleman in the room wish to take part in the discussion of this question? If not, we will consider it closed.

Question—"What is the best continuous yield in candle power per gallon obtained from an improved Lowe double superheater apparatus using gas oil of 40 degree gravity?"

Question—"Does not the candle power of the gas make a difference in these results per gallon? That is, cannot a higher yield per gallon be obtained when making a 22-candle gas than when making a 30-candle gas?"

THE SECRETARY—Those two questions can properly be answered together. I have the following reply thereto from Mr. A. B. Slater, Jr.:

“As to the questions which you sent me, would say in regard to the ‘best continuous yield in candles per gallon of 40 degree oil in the Lowe double apparatus,’ that I do not feel in position to answer that question.

“As for the other question, I have found that when making a gas from 18 to 26 candles, the oil efficiency does not vary much. In going above, say 26 candles, the amount of oil required for each candle increases, say roughly in direct proportion to the candle power obtained. In carburetting the gas, the first 10 candles take considerable oil, but to double the candle power (to 20) does not by any means require double the amount of oil. In other words, as we go down from, say, 18 candles, the oil efficiency decreases rapidly, and as we go above 26 candles, the oil efficiency again decreases, the decrease in efficiency growing more rapid as the candle power goes up.”

Question—“In a retort house with double set of benches, what are the relative advantages of having the benches back to back, with two operating floors, one on either side of the house, or benches facing each other having one operating floor in middle of house?”

THE PRESIDENT—I think Mr. Miller, of Cincinnati, can answer this question.

MR. W. A. MILLER—I do not know that I can answer the question. The only advantage that I can think of would be that there would be much less heat where the retort house was being operated on both sides rather than from the centre only; that is, the men themselves would be subjected to much less heat.

THE PRESIDENT—Cannot Mr. Sherman give us some information?

MR. SHERMAN—I have had no experience in operating that style of bench. We work our benches back to back. I have been in retort houses which were fitted up in the way the question implies, but I know nothing about the practical working of them. Personally I can see no advantage in it.

MR. A. E. FORSTALL—The advantage of a double set of benches, back to back, would be that you have only two radiating surfaces

for loss of heat, whereas in the other case you have four. This can be overcome by heavier back walls, but it would entail larger expense for building the benches. The point mentioned by Mr. Miller is a very grave one. I had the misfortune to work for a certain length of time in a retort house, where the stacks were built across the house, and there was absolutely no air in the middle of the house; and in the summer time, when we were forced by the number of retorts in action to have drawing going on in stacks facing each other, the heat was almost unbearable.

Question—"Is there a decision by any court fixing the liability for damage to gas or water mains from electrolysis, upon the trolley companies causing the damage?"

THE PRESIDENT—Can any gentleman answer that question?

MR. RAMSDELL—I understand that there has been a case tried in the State of Massachusetts and brought to a conclusion.

THE PRESIDENT—Is there any Massachusetts gentleman here who can speak as to that decision?

MR. RAMSDELL—I think it is a matter of very great importance to all of our companies, and it is a matter that has been taken up, and considerable attention paid to it—for it is of as much interest to water companies as it is to gas companies. We have been invited in one city to co-operate with the water company in bringing a local case. I would like to know, and was in hopes that someone could tell me of a case which had been already tried. I have understood that there was such a case somewhere, and I thought it was in Massachusetts, but I may be entirely mistaken as to that. Possibly there has been no decision yet reached, but I was under the impression that there had been.

THE PRESIDENT—The Secretary has just received a short topic from Mr. Rusby, of Jersey City, on the subject of Leakage. Is it your pleasure that it be read?

MR. A. C. HUMPHREYS—I move that the topic be read.

The Secretary read the following:

LEAKAGE.

By MR. J. M. RUSBY—The writer has been doing, during the past season, a little work in the reducing of leakage. The follow-

ing brief remarks give a very rough outline of methods and experience :

The method adopted for determining the location and amount of leakage in mains and services must vary in different cities, and different parts of the same city. The one which in the writer's case is largely practicable, and has been adopted, is to isolate small portions of main, shut off all consumers' meters upon them, and make an actual test through a small meter, of the leakage. This method, while apparently tedious and expensive, has the very great advantage of giving absolute information as to the condition of all piping up to the consumers' meters. Also, owing to the fact that sound piping will be accurately located and its examination avoided, the method is neither so slow nor so costly as appears at first sight.

The isolating of these districts may be done in a number of ways: By valves; by permanent appliances in main for water sealing; or by bags. The latter is the method which has thus far been used by the writer almost entirely. The method of use of bags is very simple. A hole is tapped into the main, and through this are inserted two bags, one upon each side of the hole, which are then inflated. A short wrought iron nipple is screwed into the hole. Water is then poured into the main, between the bags through the nipple, and stands in the nipple a little above top of main. In order that the bags may fit close against the main and be water tight, it is well to wash off the interior of the pipe with water before inserting the bags. If small leakage exists make a gruel of oat meal, which, being viscous, will not leak readily; or a few drops of machine oil poured in before the water will rise and stop up small crevices. But few cases will be found where a perfect seal cannot be made. We prefer white rubber bags to the black, they being less easily injured by gas or condensation in the main.

The length of main included in each test will, of course, depend upon the number of meters to be shut off, and upon possibly other circumstances. Our districts average about half a mile in length. At various points throughout this district, also, the main is uncovered and tapped. After testing the entire district, bags are inserted at the intermediate openings, and one portion after another of the district is cut off, the reduction in rate of passage of gas by meters being noted. Thus, with one

setting of the test meter, the badly leaking portions of mains can be closely located.

The cost of testing as above will average, for block or other common pavement about \$1.50 per opening in main, this covering labor and material. Valves should probably be installed in at least smaller sizes of mains for a total cost of \$10 or \$11 each. If the mains prove to not require frequent examination, the bags will be found more economical than the valves. The circumstances of each particular case will determine the best method. Bags will, however, always be found of value for at least occasional use.

After locating a section of main and pipe which is very leaky comes the close examination of services and mains for individual leaks. Barring is the chief means used by us. A bar is used which is 5 feet long, $1\frac{1}{4}$ inches in diameter, and tapering gradually; it is finished with a square head, upon which is fitted a handle 30 inches long, by which the bar is twisted and lifted. Barring can be successfully done through asphalt pavement even on concrete foundation, by using, before the above long bar, a very short and stout one to start the hole through the pavement. It is important that not only shall the bar be put down right over the main, but over the joint as well. Therefore, uncover the main at each end of a block, locate the line of main, and also locate the position of two joints; from these measure off and mark on pavement the position of each joint on line. It is our system to permanently locate two or three joints in each block by marks upon the curb-stones; this will render entirely unnecessary future digging to locate joint ahead of barring. We also keep accurate sketches showing locations of specials, distance of main from curb, etc. The connection of services with mains is also barred over. An inspection of services in house cellars will give valuable information as to their age and probable condition in street. The service may be dug up at main, and if it shows sign of any considerable age, it may be worth while to cut it, attach a pressure gauge, blow three or four inches pressure upon it, and note its soundness. It is well, while mains are being examined and repaired, to make the work thorough: renew, for instance, any service that is likely to give trouble within the next three or four years.

The work of barring and testing mains and services, demands care and patience. In some soils barring must be done very close

to a leak, or it will not be discovered. In such cases it may be well to bar midway between main joints as well as at joints. In some cases, nothing will serve but continued sub-dividing of lines of main, testing by meter or gauge, and after this liberal digging. The great advantage of testing is that the amount of leakage being definitely shown, one is not apt to abandon repair until every bit of trouble is found and corrected.

The leakage existing at our own plant is found to be very largely in street lamps and house services. Certain portions of our plant are very old, indeed. Some old services not in use have been lost sight of, never cut at main, and are now among our most prodigal consumers. Other services, old, but in use and apparently sound, are found corroded at curb or elsewhere.

It is our present system to connect services to mains by a double elbow, forming a swing joint; this gives flexibility to the service joint above main. In former years this practice did not exist and we find very many of the old style connections cracked or broken off. Pipes which, in laying, have been sprung into place and left with a strain upon them, are pretty sure to give trouble by breakage, sooner or later, under jar or partial corrosion. Exposed deeply-cut threads also give trouble, being easily liable to breakage or corrosion, as the metal is thin and soft; we now carefully protect all exposed threads with a wrapping of cloth and white lead. Shallow mains in heavily traveled streets are a source of trouble. Crosses and tees at street intersections are also especially liable to show leakage at joints.

We keep a card record of all mains repaired, giving detail of cause of leakage. We also keep a card record of every service examined or repaired, with a note as to its condition; reference to these will undoubtedly save much trouble in locating future leaks. We keep a memorandum book containing information as to places likely to give future trouble; as, for instance, a stretch of shallow, small or old main; a place where joints are disturbed by heavy traffic; a section of city containing many old services, etc. We also keep a sketch book containing diagrams of our test districts, with records of various tests made upon each.

In addition to the foregoing remarks, which chiefly concern the correcting of existing leakage, it may be worth while to add one or two hints as to means for its avoidance, etc., although they will probably be largely unnecessary to you.

All our service pipe now laid is coated with service mixture. For method and composition, see paper of Mr. A. C. Humphreys, read before this Association last year. In addition to being coated at store room, another coat is applied to the pipe after it is in position in trench. In bad soils, or under trolley tracks, the pipe is further wrapped with a layer of cheap cloth and again smeared with a very heavy coat of melted asphalt, slightly diluted with thin tar; or, in some cases is laid in a trough and is covered with asphalt.

Our mains are laid almost entirely with cement joints. Main pipe is hammer-tested and carefully inspected before laying. After laying, and before being covered, it is tested under gauge, about 8" water pressure being used.

The station meter should, of course, receive special attention. Its water level should be carefully established. In proving it to fix the water level, its drum should be made absolutely tight, at least temporarily. Small leaks, which in the regular operation of the meter may be insignificant, may, at the slow rate of passage of gas in proving, introduce serious error, and render worthless the determination of water level. After the water level has been fixed, the meter should be occasionally proven to check its tightness. Tests at two different rates (say 600 ft. per hour and 100 ft. per hour) will clearly show tightness; if the amounts passed by proving meter differ, leakage exists. By reading the proving meter for fractions of the rotation of the station meter drum and comparing these readings, leakage can be still more clearly shown, and approximately located. By removing the man-holes of meter case above the drum, and passing ropes around the latter, thus holding it at any desired position, and applying a moderate pressure (not to exceed the safe working "head"), the position and magnitude of leaks can be ascertained; or, pressure can be applied to the various compartments of drum, through the plugs regularly provided, and the same information obtained. By these means, the "seal" upon meter compartments can be checked, if it is uncertain. Every station meter is supposed, of course, to be provided with a water overflow, in which the water is subjected to the pressure of gas at meter *inlet*, which, if kept in order, insures constant water level from hour to hour, and day to day. The meter should run with uniform back pressure. There is nobody, it is hoped, who fails to correct the monthly station meter reading for temperature, as this is liable

to occasion much discrepancy in gas. A thermometer thrust into the meter outlet and read frequently day and night, these readings being footed up and averaged for the month, give an average temperature which, while not quite correct for several reasons, may be made pretty nearly right. Tables of correcting factors by which to multiply the station meter reading, will be found in numerous places; they are given in Newbigging's Handbook, 1885, pages 252 and 253. and also in King, page 261.

Slow registration of consumers' meters is especially bad, because it means loss of gas at selling price, instead of at holder cost. We remove for proving and repair, if latter be needed, small sizes every three years, and large ones every year. In addition to this, every meter removed for incidental causes, no matter what its previous period of service, is given proof also. We succeed in keeping our meters in a condition of nearly correct registration.

Although unavoidable, difference of pressure in station and consumers' meters occasions some discrepancy. A pressure of 6" of water in station meter and 2" in the consumers' meter means a difference in registration of about 1 per cent., which is in direction of less apparent leakage.

Condensation of illuminants and water vapor also produce some discrepancy. The former influence should be trifling. As to water vapor, gas measured at the station meter at 60 degrees Fahr. and 30" barometer contains about 1.5 per cent. by volume of water vapor. At 32 degrees it contains a little more than .5 per cent. In winter, therefore if gas be cooled in mains to 32 degrees, and if the vapor condensed be actually thrown down, the gas on warming up at the consumer's premises will still be short in registration by this difference in per cent.

To the important matter of effect upon registration of high and low temperatures at the consumer's meter we can only refer. We hoped to present at least a *little* data upon this point, but have not had time to collect it.

THE PRESIDENT—We all regret that Mr. Rusby is not here to have read this paper himself and to take part in the discussion. The paper opens up a number of new ideas, or at least things which have not occurred to some of us before. It is now open for discussion.

MR. A. C. HUMPHREYS—This is a very important subject. I would like to refer to one point which is not, I think, mentioned in

the paper, namely, the inspection of the holder. I think some leakage accounts have been reduced by a careful inspection of the holders, and especially of the crowns of the holders.

MR. W. R. BEAL—I have had a great deal of experience in this matter of leakage; but it is getting late, and I do not think I could say anything in this closing hour which would be wise enough either to entertain or to enlighten the members present. We have had a very large experience in this way. We are in a suburban part of the city and have had our pipes interfered with very much at times by the digging of sewers. Consequently, we have been obliged to spend a great deal of money every year to go over our lines in order to stop leakage. We find it very difficult in our town to have such thorough inspection as Mr. Rusby suggests because of the difficulties of opening up the asphalt roads, which are there kept in order by the contractors. As the repairs must all be done by the contractors, and permission to open the streets must be obtained from them, it makes it almost impossible for us to open asphalted roads; and we only do it when absolutely necessary. We have been obliged, as I say, to follow up the public contractors, and while I am less satisfied with our leakage matters than with almost any other feature of our business, we have succeeded fairly well in keeping the account down. I do not like to state just the figure. It is a very important matter, and we make short work of it where the difficulties are not almost insurmountable.

MR. JENKINS—I presume nearly all the members here know that I prepared a paper on leakage for the Western Association last May; since that time I have had some additional experience which may be of value. I have brought here a piece of pipe which may prove somewhat interesting. This pipe was the riser of a lamp post. To a certain extent it proves something about electrolysis. It is not electrolysis, but it is the result of electrical action. A trolley line ran around the corner where this lamp post was standing; and the line fell one afternoon as a car was passing. In order to keep the cars passing up and down the street on the other side, the motorman and conductor attempted to pull the trolley around on the other side without interfering with the direct line; and in doing so they used a rope tied at one end to the trolley and at the other end to the lamp post; as they pulled it over, the trolley line struck the lamp post, and the current of

course hit the lamp post. This inner pipe was a quarter of an inch from the lamp post, and it made a decided arc, and in about ten seconds a hole was made in the pipe and a stream of ignited gas was going out of the top of the post. This pipe will show you the effect of the electric current. That same thing might occur in a business block, or anywhere else, if a cross current should be thrown on to one of our gas pipes from a trolley system, or from a common arc light. I also have here a piece of a broken cast iron main. You will notice that the casting is thoroughly honey-combed; how it could possibly have lasted so long I do not know, but it has stood for perhaps thirty years. This casting would go to prove another thing. Take the case of the recent Boston accident. Now suppose we should have had a pipe like that broken (whether large or small), and finally there comes an accident; that could not be considered as contributory negligence by any means, and the gas company could not be held responsible because even with the best of care and inspection you probably could not have found the defect; and it was not due to any negligence upon the part of the gas company. These are little things which come along and show what we have to contend with. I think the principal and most interesting point in the paper just read is that which relates to the isolation and testing of districts. I have tried that as far as possible, and have made a number of experiments in that line during the last year. I came to the conclusion that if there was a system by which you could easily and quickly cut off a section of the town, and test that section, you would be able to locate your leakage very readily. As an instance I may mention that last November our leakage was, say, 450,000 feet; in December it was over a million feet. We tried our best to locate it, but did not succeed until last August. Nowhere in the city was there any indication of large leakage. We drilled all the mains, or barred the mains rather, but left the opening of the asphalt streets until the last, on account of the warm weather. We found two four-inch breaks under the asphalt streets, one of which was caused by a leak in a water main under our main, letting it down; and the other was caused by a sewer caving in. If the mains in our city had been properly arranged we could inside of two weeks have tested every portion of the city and discovered just where the leak was, and could have saved the difference in leakage for the time between December and August—say 300,000

feet per month. I have studied this matter considerably, and after my paper at Cincinnati my attention was called to the Bouvier system, and I have had some correspondence with the agent, who is in the United States at the present time. That system has been illustrated in this hotel since we have been here, and it would be well for the members to study it carefully. Although at first it would seem rather expensive, yet in the long run I think it would pay to adopt something of that kind, whether it be that system or some other. We know what is done in Boston with the valve system. They make their tests by sections, and do it very quickly; and it has been of very great advantage to them to be able to do so. I have arranged to make a test of the Bouvier system in Covington, and will probably be able to say more about it at the next meeting.

MR. SEARLE—I want to say a word with regard to isolating. In barring over about thirty miles of main, costing approximately \$1,000, we found in the last three miles 255 leaks, while in the 27 miles we found only 71 leaks. We used up the appropriation before we got to where the leaks were. If we had isolated it a long time ago nine-tenths of the money would have been saved.

MR. A. C. HUMPHREYS—It is well to bear in mind that the isolation of sections will not be of much service in cities where there is a large leakage. Unfortunately that applies to many places in the United States. You may go into any street and find plenty of leakage from bad joints in the mains, or rusted-out service pipes. If the superintendent has any reason for believing that that is so in his particular case, he might just as well get right down into the street and go over every joint and every service pipe, for then his appropriation will last longer in the end. I do not question for a moment that the instances referred to by Mr. Jenkins and Mr. Searle were eminently proper cases for the use of the isolation system, but do not let us deceive ourselves by believing that isolation is a sure remedy by any means.

MR. JENKINS—Don't you think that to be able to make a test once or twice every week or ten days would be of great advantage in enabling us to determine whether there was an excessive leakage in any particular section? For instance, I tested fifteen sections in the city of Covington last spring, and of the fifteen only selected eight for inspection; the other sections did not need any care at

all. Those eight that we did select paid us handsomely in a very short time.

MR. A. C. HUMPHREYS—I will answer by saying that if I came into control of a works where there was a large leakage, I would not bother about isolation; I would at once go to work at all the joints. I do not think I would even go to barring. After I got my mains and services in good condition, I would then follow up the method of isolation. In other words, isolation applies to a system which is generally good, but which has deficiencies and defects. But if you once get your mains in fairly good condition, then it would undoubtedly be of great advantage to be able to isolate, and keep a constant watch in that way.

MR. PRICHARD—It has been my custom for many years to isolate the mains in the general manner spoken of. We began at first by putting a large meter at our works to measure the output; and if at any time in the year it showed an excessive output, we immediately went out on our sections. That worked first rate for quite a number of years. But since we have been pushing the gas stove and heater business, I find that the whole system has gone out of use. It is impossible to do anything with it. Now, whenever we isolate a section, we deprive the people of the use of the gas stove for a while. We find the better way is to get right down every spring and bar the whole main system from one end to the other.

MR. LITTLEHALES—I made the same test that Mr. Prichard has spoken of, and met with the same difficulty. I tried it from four to five o'clock in the morning, and thought I would surely get something like reliable data, but the test was a most unsatisfactory one, for the reason that there were quite a few heaters then going, and that in many stores and houses they had left a little gas burning all night. I found the best time for making the test was from three to five o'clock on Sunday afternoon. I think that is the best time of the whole week. If you do it at any other time, there will be a tendency to inconvenience the public to a greater or less extent; but at that time, on Sunday afternoons, you can generally get a pretty fair result. I found that by the gas then going out, we could get a very fair approximation to what our actual leakage was; but the early morning, from four to five o'clock, gave us no criterion whatever in the matter.

On motion of Mr. Humphreys the thanks of the Association were voted to Mr. Rusby for his paper.

THE PRESIDENT—Is there any other business to come before the Association ?

MR. RAMSDELL—Before the adjournment I would like to make a motion, and I am quite sure that everyone in the room will vote in the affirmative upon the question. I think we all agree that this has been one of the pleasantest and most profitable meetings that the Association has ever held, and we all recognize the fact that its success has been largely owing to our officers. I would therefore move a standing vote of thanks to President Nettleton for the able manner in which he has conducted this meeting.

The motion was seconded by Mr. Beal, the question was put by Mr. Ramsdell and carried by a rising vote.

MR. A. C. HUMPHREYS—As a member of the Committee of Arrangements I would like to move the thanks of the Association to the officers and managers of the Old Dominion Steamship Company for the courtesies they have extended to the members, and especially in view of the boat trip we are to have to-morrow. I would like to have such a resolution passed for the reason that I happen to know that they have put themselves out a very great deal for our comfort and accommodation and have interfered with their own arrangements in so doing.

THE PRESIDENT—It gives me a great deal of pleasure to put that motion. Mr. Humphreys was too modest to state a fact which is known to some of us—that they have put themselves out, and have done what they have, out of their regard for Mr. Humphreys.

Carried.

MR. McDONALD—I rise to move a vote of thanks to the Committee of Arrangements, of which Mr. Humphreys has the honor to be one ; and I know that this motion deserves and will receive the very hearty approval of all the members of the Association. I cannot help but say that I believe this has been one of the most delightful times this Association has ever experienced ; and very much of the pleasure we have shared is due to the efforts of that Committee.

Seconded, put and carried by a rising vote.

THE PRESIDENT—And now, gentlemen, I would like to propose a vote of thanks to our Secretary. We all appreciate how greatly the success of any meeting depends upon the labors of the Secretary; and no one knows better than the President how well or poorly the Secretary works at any particular meeting. It has been exceedingly pleasant to work with Mr. Forstall in the preparations for this meeting, and how well he has done his work you know by the great success of the meeting in every respect. Without waiting for the motion to be seconded I will request those in favor of it to rise.

Carried by a rising vote.

The Association then took a recess until the return of the excursion on Friday afternoon, October 21st, when the final adjournment was had.

THE PROCEEDINGS

OF THE

American Gas Light Association.

TWENTY-FIFTH ANNUAL MEETING.

1897.

APPENDIX.

PAPERS READ AT THE MEETING:

A Quadruplex Purifying Box; Why Not? F. H. Shelton.....	i
Some Further Experiments on Interior Illumination. Alten S. Miller	xiii
Report on Burner Stoppages, Paul Doty.....	xx
Chemical Notes on Purification, Henry A. Mather.....	xxxvii
Rust Deposits in House Pipes, Fred B. Wheeler.....	xliii
Gas Advertising, R. M. Searle.....	liv
A Method Successfully Employed to Obviate Trouble from Naphthaline, K. M. Mitchell.....	lxii
In Memoriam	lxxi
“ Joseph R. Thomas.....	lxxiii
“ Joseph D. Weeks.....	lxxiv
“ John W. Newell.....	lxxv
“ Frederick W. Norton.....	lxxvi
United States Patents Relating to Gas. Issued October 1st, 1896 to October 1st, 1897.....	lxxvii
United States Patents Relating to Gas. Expired October 1st, 1896 to October 1st, 1897.....	cvii
Current Gas Literature, Index of.....	cxvi
New Publications	clxiv
List of Officers for 1897-1898	clxv
“ “ Members, Alphabetical, Honorary.....	clxvii
“ “ “ “ Active	clxviii
“ “ “ “ Associate.....	cxcvi
“ “ “ “ Geographical	ccii
“ “ “ “ Deceased	ccxvii



A QUADRUPLEX PURIFYING BOX; WHY NOT?

WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY F. H. SHELTON, CHICAGO, ILL.

*Mr. President, and Gentlemen of the American Gas Light
Association:*

The earliest purification of gas was by the use of wet lime. In 1817, in England, Reuben Phillips first used a dry lime process, and in 1823 John Malam, also in England, in improving upon Phillips' equipment, proposed and used four shallow boxes arranged in a square, having water seals, removable lids and trays and a (wet) centre-seal, in short, practically the equipment that is in universal use to-day. It is a remarkable fact that from that date to this no change of moment has been made in gas purifiers, nor has any other form than the above, as far as real use goes, even got a foothold. Throughout this country and in Great Britain as well, I am reliably informed (and probably in the other civilized countries also), purifiers are built to-day essentially as they were seventy-four years ago, and as alike as peas in a pod. In all that time the only changes that have taken place have been the substitution for the old wet centre-seal of one form or another of dry centre seal or dry valve systems, and betterments in details, such as the mechanical means for lifting the covers, handling the purifying material, etc. Oxide, it is true, has been largely substituted for lime, in the larger and better works almost universally, but this is a change in the *process* of purification, and neither involves nor has made any change in the form of boxes used.

Purifiers as constructed are undoubtedly simple and effective, and the use of some form of oxide—easily revived and usable over and over again—has reduced the cost of purification to so low a point that we have perhaps fallen into the habit of thinking that our present methods and our present boxes are about as good as

can be. As far as the use of oxide goes this for the present may be so. The customary form and arrangement of boxes, however, is far from being as good as can be. A little thought will show this and that there are several distinctly objectionable features in the present design, which, if eliminated, would make any form not having such features better and more desirable

(A) For instance, boxes as now built take up a very great amount of room. Think of the small cubic space actually occupied by the oxide in a purifier building compared with the total space in the building or that occupied by the connections and necessary for the cover-lifting machinery, the off box, etc., all of which space means proportionate building expense and often valuable yard room. Would not a form requiring but a half or a third as much be a great improvement?

(B) In the present wrought iron covers, and in their hoisting rigs is where a large portion of first cost is now involved and where most of the expense for purifier repairs occurs. Would not a box be better that had no cover side plates to rust out; in fact no cover to hoist?

(C) Present boxes involve an expensive centre-seal, or eight-way valve that does not always stay tight, or else a complex valve system that is confusing, as well as many feet of pipe connections that afford large chance for stoppages and back pressure, more especially in the smaller works. Would not an equipment needing but a third the ordinary amount of connections and but four plain gate valves be better?

(D) Ordinary boxes have open water seals that in winter require considerable heat to keep from freezing and that at all times are liable to "blow." Gas escaping from such seals has caused disastrous explosions. Through some workman's carelessness one's own turn may be next. Would not a form having no water seal but a cover not necessary to remove, made on and tight as a station-meter, much increase safety?

I think it is evident that there is not only room for a better form of box, but also that such better form, if covering the points above mentioned, would be distinctly desirable. I believe that I have evolved such better form and I have the honor and the pleasure of herewith submitting it to this Association.

The general scheme of this new gas purifying box, which I have called the "Quadruplex," or four-in-one, is based upon the fact

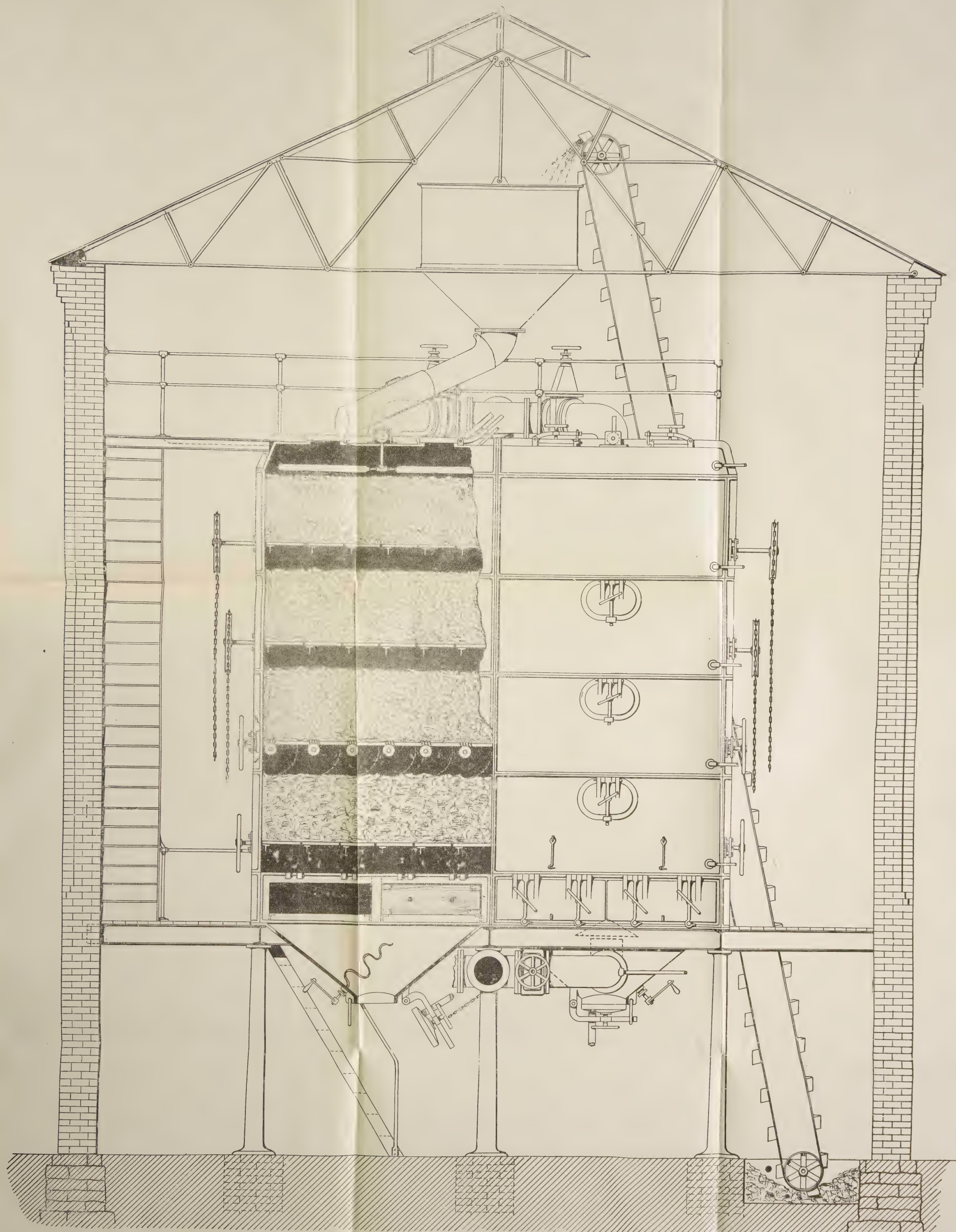
that oxide, after use, unlike lime, is not caked, but will run, and can be handled entirely by gravity, and that such being the case, *a removable cover to a purifying box is not necessary for emptying it of oxide*, where it has been in the past, to give access for the removal of lime. In the utilization of this fact, space is saved over the present arrangement by locating all four boxes, in effect, not over another, uniting them into one structure. Water cups or seals, wrought iron covers, and all cover-hoisting devices are omitted *in toto* by the use instead of a stationary, tight, cast iron cover. The oxide for purifying is passed into the box by gravity through holes in the cover; is automatically spread and levelled within, and is finally, when foul, drawn out by gravity through hoppers at the bottom. Having one large four fold box in place of the usual four separate ones, permits of reducing the piping by two-thirds and of replacing the centre-seal by four plain valves. Incidental minor advantages are secured.

The drawings accompanying show all this more clearly. The first three sheets show a Quadruplex box, 12x16 feet in area, the equivalent of a set of four common boxes of that size, such as would be used by an ordinary small works. The fourth sheet shows the outline plan and elevation of a Quadruplex box, 18x54 feet, the equivalent of a set of four boxes, 30x30 feet, illustrating how the Quadruplex would appear when built in a large works. The Quadruplex equivalent of a set of any desired size of ordinary boxes can be made without difficulty. The building is entirely above the ground level (involving no cellar), has a cement floor for revivification purposes and the usual roof and ventilator. Note that it is of but little greater height than that required or commonly built for ordinary boxes. To be specific, a suitable building for the 12x16-foot size of box shown would be 27 feet wide inside, 22 feet long and preferably 30 feet to eaves. The inside floor space is 594 square feet. The cubic space (excluding that within the roof) is 17,820 cubic feet. The building for four ordinary boxes arranged for six-foot aisles and but 2½ feet between walls and boxes, would be about 37x45 feet, by about 26 feet to eaves, and would have a floor area and cubic volume of 1,665 square feet and 43,290 cubic feet respectively. The cubic space required for the Quadruplex form, therefore, compared with that of the ordinary, is but 41 per cent. and the floor space but 35 per cent. A comparison of large sizes may be conveniently made with the purifying house

at the works of the Universal Gas Co. in Chicago. The plant has a capacity of 10,000,000 cubic feet per day and includes probably the largest purifying equipment recently built in the country. The building inside is about 93x172x31 feet to eaves and contains eight boxes 36x36x6 feet, arranged in a double row of four each. A building 85x72x36 feet inside would suitably contain two 20x65-foot Quadruplex boxes, affording an equal total purifying capacity, and would involve but 44 per cent. of the cubic space and but 38 per cent. of the floor space of the other. To return to the drawings: Wrought steel I-beams and cast iron columns support the box in the same manner that ordinary ones are supported. The cast iron top of the box is rigidly bolted to the sides. Four hoppers form the bottom, each being fitted with a self-sealing clamping lid. In these lids are drain pipes for the removal of any condensation. Within the box are four layers of ordinary trays, each designed to carry from one to three feet of oxide, or the equivalent of the oxide carried in each one of the separate boxes of the usual setting. These trays are bolted in parallel rows to supporting T iron cross bars, about 6 or 8 feet long, which bars are fitted with round or axle ends. (See detail sketch of bar and tray in plan drawing.) These ends rest and work in suitable sockets or supporting links attached to the side plates of the box and to transverse midway supporting I-beams. The T bars at one end are also fitted with small cog and worm gears, operated by shafts and outside wheels. Each wheel operates one section or one quarter of the trays in one level only. The two lower sets of wheels are handwheels; the two upper ones, above the head level, are sprocket wheels, fitted with chains, to enable convenient operation from the floor level. The whole arrangement forms in effect a series of *collapsible grid floors*, each row of trays being in effect hinged and all the trays on a level dropping their load of purifying material to the trays below when the proper handwheels are operated. A small arm, similar to a semaphore blade, is located near each wheel and is so geared or connected to the shaft to which the wheel is attached that it at all times corresponds in position to the trays inside, thus indicating externally to the workman their position or degree of inclination and hence when to lock the wheel after operating it.

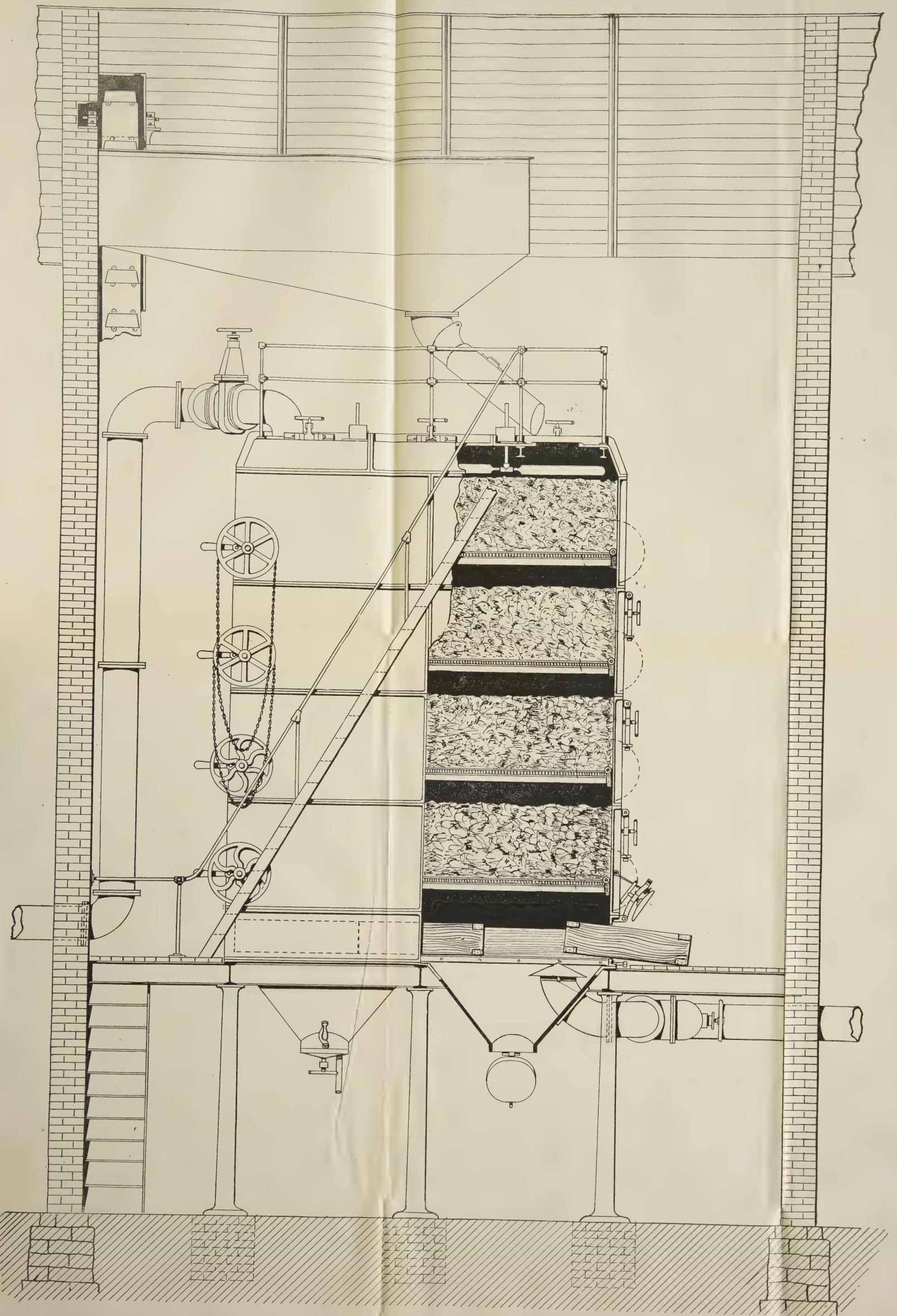
A gas tight partition divides the box into two non-communicating compartments, and the gas inlet at the bottom, dividing, connects with them in such way that gas can be sent through either

THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS



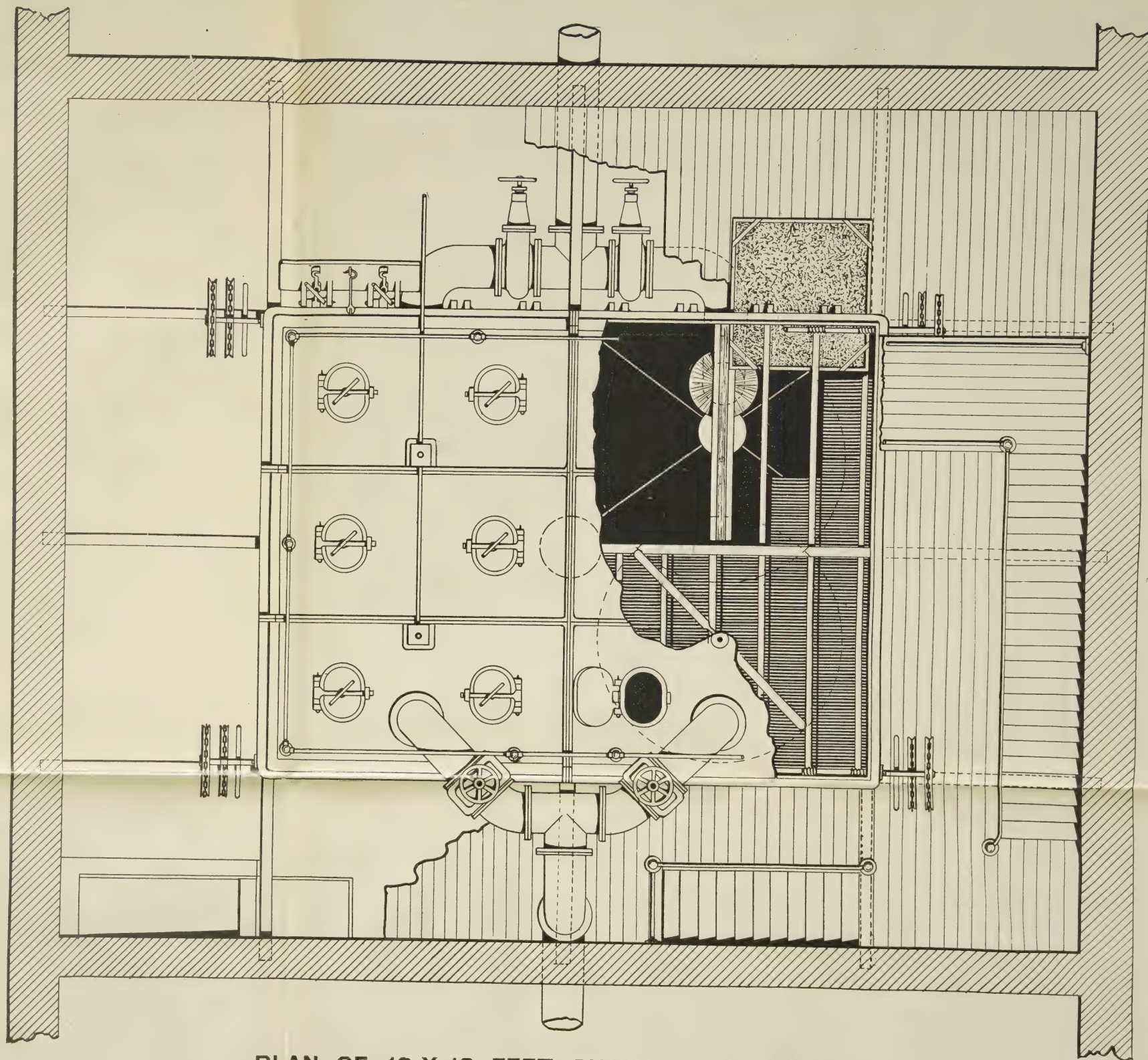
SIDE ELEVATION OF 12 X 16 FEET QUADRUPLEX PURIFIER.

August, 1897. F. H. SHELTON.



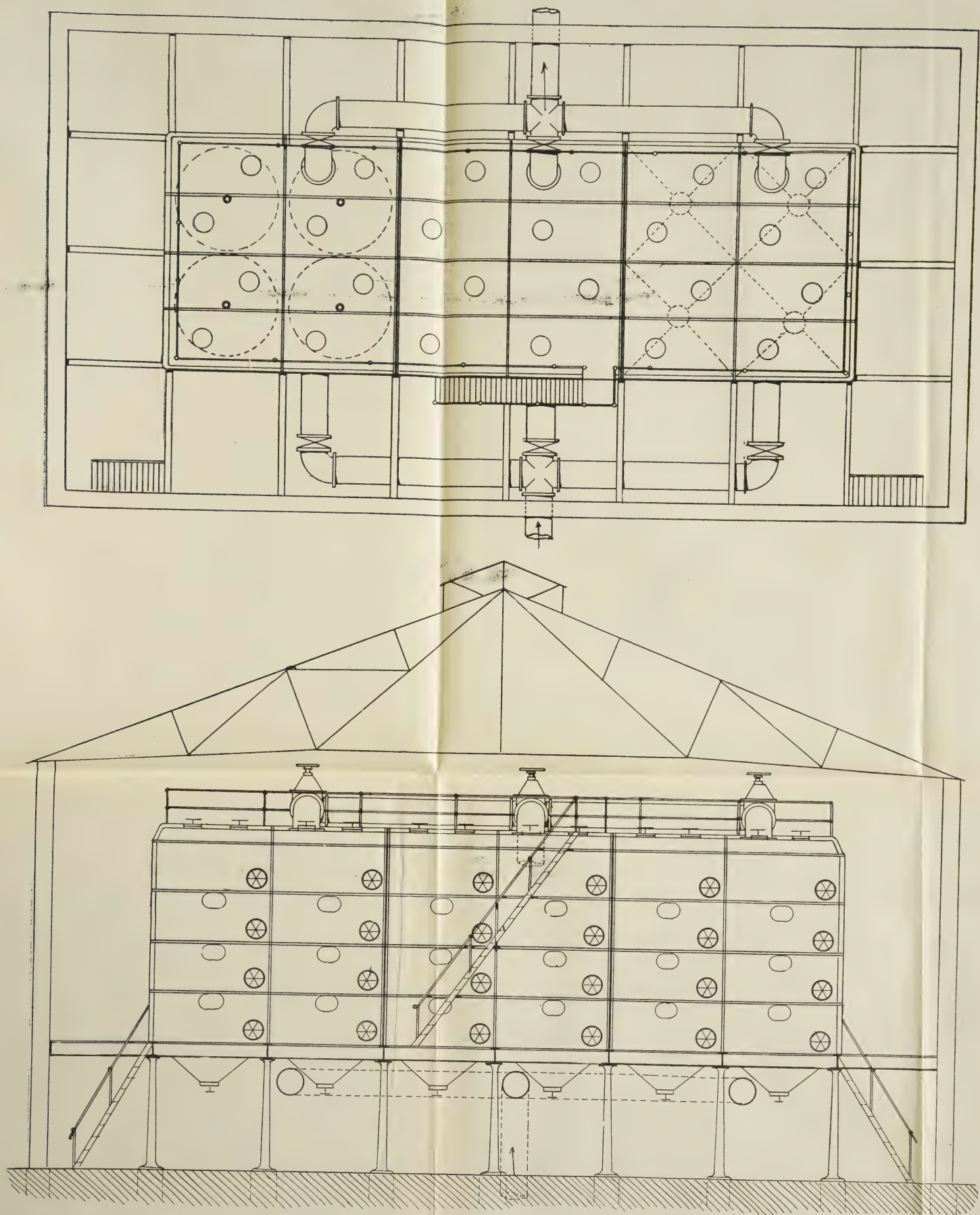
END ELEVATION OF 12 X 16 FEET QUADRUPLEX PURIFIER.

August, 1897. F. H. SHELTON.



PLAN OF 12 X 16 FEET QUADRUPLEX PURIFIER.
August, 1897. F. H. SHELTON.

THE LIBRARY
OF THE
UNIVERSITY OF MICHIGAN



OUTLINE, PLAN AND ELEVATION OF 18 X 54 FEET QUADRUPLEX PURIFIER.
 (EQUIVALENT TO 4 BOXES 30 X 30 FEET).

August, 1897. F. H. SHELTON.

or both. At the top the respective gas outlets unite in the pipe leading to the station meter. Four valves control the entire arrangement. The piping aggregates less than 50 feet. In an ordinary typical setting of four 12x16-foot boxes, the total pipe within the four walls of purifier house is about 150 feet. A light iron stairway, or ladder, leads to the top; there, a gas pipe railing is supplied to prevent inadvertently stepping off. On the top-head are self-sealing oxide-charging doors. These also serve as manholes at that point. Other manholes are located on the sides, to give access to the three lower layers of trays. While facilities for communication with the interior can easily be further increased, even to the extent of arranging for opening entire side plates, hinged, at each tray level, if desired, it is in my judgment that the manholes shown will be all sufficient.

Pressure gauge pipes are led off from six different points in each half of the box to indicate the gas pressure at the inlet, the outlet and between each oxide layer. These pipes run to a gauge board (not shown), are there fitted with quick-purging blow-off cocks, and afford opportunity for making the usual lead-pipe sulphur tests upon the gas from any point in the box. A wood flooring, such as is usually put around boxes, is laid over the I-beams. Purifier equipments ordinarily are not fitted with a bypass to them as a whole. If such is desired, however, it can easily be added to the Quadruplex form by a short pipe underneath the box connecting the inlet and outlet pipes.

The filling and operation of a new box entirely empty is as follows: An overhead bin, conveniently hung from or located in the roof trusses, is filled with oxide and kept supplied by a customary conveyor, located against the wall, which conveyor may be of belt form as shown or of any other desired. A movable, adjustable (telescopic) spout guides the oxide from the bin to the several charging doors in turn, through which the oxide enters. It falls and builds up in heaps inside on the top trays, and immediately is spread and levelled by a pair of rotating blades inside, operated (during the filling process only) by small bevel gears. These gears have removable dust covers, are conveniently connected with power from the conveyor-shafts near by, and preferably have a clutch device to enable easy starting and stopping as desired. The rotating blades—very like a revolving fly or ventilating fan—are adjustable as to their horizontal plane of action by an external

set screw and collar device, so that by raising or lowering them, the oxide may be gauged for and levelled off at any depth desired. When the top trays are filled with oxide to the depth that is desired it shall be carried, the supply is stopped. The upper hand-wheels are operated and the oxide is poured to the next layer of trays below. The wheels controlling that layer are in turn operated, again pouring the oxide downward, and it is so passed from tray to tray until it reaches the lowest set or level where it rests. The trays above it are in turn then filled by like means, and the operation is duplicated to fill the compartment the other side of the partition. The box now being filled with oxide, the charging-doors, etc., are closed, gas is turned on through both compartments, and the purification process is then in full operation. It will be seen from the drawing that the gas passes successively through the several layers or masses of oxide in the Quadruplex box, in precisely the same order that it goes through the several beds of oxide in a set of ordinary boxes each layer corresponding to a box. Entering at the bottom it goes through one after another, emerging at the top. The lower or first layer met becomes foul first; the top or last layer last.

To "clean a box," so to speak—or to renew the oxide in the Quadruplex when the lower layer has become so foul as to require renewal—is simplicity itself. The gas for a brief period only is shut off from one compartment, letting it temporarily all go through the other; the charging-doors and hopper-lids are opened. The wheels operating the lower trays are turned, and the foul oxide is dumped into the hoppers and runs out below for revivification. Not a shovel is handled to discharge the oxide, and but a few minutes time and but little labor is required. If the oxide sticks or packs in the hopper, the occasional turning of a spiral rod, or other agitating device, located in the mouth of the hopper, will loosen it and keep it moving. The empty bottom trays are then returned to the normal horizontal position, and the less foul and still usable oxide on the second level from the bottom is poured on to them. The still less foul oxide from the third level is in turn poured on to the second, and the comparatively fresh oxide on the top trays is passed in turn to the trays below, leaving the top trays empty to be at once refilled with quite fresh oxide from the bin. Gas is then turned on again, and the entire operation repeated in the other compartment. It is the belief of the writer that the mechan-

ical means indicated for discharging old and putting in new oxide will be so speedy and effective that the operation of renewing a layer can be accomplished in comparatively few minutes, say half an hour or so, compared with the several hours usually necessary to clean and refill a box of the ordinary kind, so that so little time being consumed, one can, with the Quadruplex, operate, if desired, with four layers in use practically all the time, thus having the equivalent in capacity of four ordinary boxes in operation at once, instead of the usual three. It may be noted in passing, that the operator in working the trays does not have to lift any weight whatsoever of oxide. The trays are moved down, away from their load, which simply follows its disappearing support, until the inclination of the trays is so great that it slides off through the openings made, to the trays below.

It is quite evident that the satisfactory working of the Quadruplex purifier is dependent upon the oxide starting level in the box and continuing to be practically level in its passage from tray to tray. To satisfy myself as to the efficiency of the means provided for that end, I constructed a working model $\frac{1}{4}$ scale and operated it with various materials to represent the different weights of oxide. The results were entirely satisfactory. The rotating blades distributed the material excellently, irrespective of density, leaving it perfectly level in the main and (desirably) slightly deeper around the edges and in the corners. In passing the material from tray to tray it was found, as was to be expected, that as all the trays in a section commence to pour at once, and in separate parallel rows, the mass falls entirely uniformly, and that when it is again at rest on the trays below, the top surface is found to be comparatively and sufficiently level without the use of rotating blades at each level. The top surface is made up of shallow parallel ridges, which, by a knack in the proper speed of operating the trays, are reduced to such a minimum as not to amount to anything. The several materials, with openings 3 inches wide, did not bridge or refuse to fall in the least, so that with the openings of 12, 15 or 18 inches, that would obtain in a full size box, it is safe to assume that the oxide will surely fall as soon as the openings grow to sufficient size after the trays start moving. Observations and experiments with several different makes and lots of representative foul oxide further satisfy me that it will not bridge or refuse to fall in the Quadruplex box. In no case could I make foul oxide stay up or bridge over

parallel openings but $\frac{1}{6}$ the width of those that will be made by the moving trays. It may be noted that the moving oxide does not fall bodily, but is slowly poured, because of the slow action of the worm gear, purposely used to avoid jar from the weight of the moving mass. In a three-foot bed the weight per square foot on the trays (of oxide weighing 40 pounds per struck bushel) would be about 96 pounds. The heaviest oxide likely to be used would not be apt to exceed a weight of 144 pounds per square foot. The trays are strong enough, however to carry 200 pounds or more.

Structurally, the box will be made of cast iron plates, with planed bolted joints, precisely as purifier boxes are now made. It may be observed that the top, bottom and sides of the box will be conveniently and amply tied together by the partition inside, together with the I-beams at right angles with it in the centre, that at four separate levels support the inner ends of the T iron tray bars. The weight of the box, with its contents will, of course, much exceed the weight of an ordinary one, but it is not so great as to call for expensive foundations. I have figured the weight of the filled 12x16-foot Quadruplex box under consideration, and find that it can be easily carried on either three 18-inch I-beams, spanning from wall to wall, without columns, or else on the ordinary 8-inch I-beams shown, that in turn rest upon nine columns, and at twelve points in the adjacent walls. Assuming the entire weight to rest upon the nine columns only, and that they in turn, through proper base plates, distribute the weight upon piers 30 inches square, the load per square foot on these piers is only about 2,000 pounds. This is less per square foot than the weight on foundations under the superheaters of water gas apparatus, so that in brief such foundations of ordinary depth and character as suffice for water gas sets or for large station-meters will carry the Quadruplex purifier.

The box may be built with only the features so far described. With such, however, it is limited to the use of oxide alone and is only suitable for such companies—and there are many of them—as use this material without a layer of sawdust (or other similar material) for catching tar. There are numerous companies, however, that, from insufficient condensing capacity or from a desire to be on the safe side, habitually use a layer of sawdust in their purifiers for catching tarry vapors that may get over. For such companies desiring to continue the practice, the Quadruplex may easily be arranged to the same end as follows: Its height is increased

about 20 inches by the insertion of a row of side plates of that height, immediately next to the bottom. In these plates, on one side in small boxes—and on two (opposite) sides in large ones—are openings about 13 inches high, extending across the full width of the compartments within. Rectangular doors with faced joints cover these openings. Inside, flush with the openings, and at right angles to them, run horizontal parallel strips of, say, 2-inch angle iron. On these angle irons, as on tracks or guides, successive crates or boxes filled with sawdust are pushed in through the openings in the side plates, just as one pushes in a bureau drawer, until the whole area of the box is covered with them, thus interposing a layer of sawdust clear across the bottom of it. The crates have no tops; the bottoms are made of purifier slats, the sides of hard wood. The corners are iron bound and the whole braced with light iron through bolts to preserve the squareness of the box despite any rough handling. Made about 4 feet square by 12 inches deep, they may be filled to any depth desired with breeze, chips, sawdust, or any other suitable material, and are of a size and weight to readily stack up, or to be wheeled in and out from the yard on a flat-bottomed wheelbarrow. By the use of crates of this sort the sawdust is handled *in packages* so to speak. Filled outside, they are wheeled in, inserted and used. When foul, they are withdrawn by hooks, wheeled out and dumped. I submit that this is an easier and much cleaner method than the present one of shovelling out from foul purifiers, inside the purifier room, tarry mucky sawdust in bulk. With a Quadruplex box having this feature, the dumping of the lower tray of oxide into the hoppers would, of course, be done when the sawdust boxes are withdrawn.

Purification practice is steadily growing to the use of oxide alone without lime, it being a question whether there is any net loss of candle-power found, or whether any extra amount of enriching material is necessary because of the non-removal of carbonic acid. Many of the best and largest companies so operate. For those, however, who desire to use a layer of lime in their boxes, the Quadruplex can be arranged with strata, so to speak, of boxes at either the top or the bottom for containing lime similar to the sawdust boxes described. Situated preferably at the top would mean a light hoisting rig for the elevation of the lime crates and more or less of a platform above for handling them there. While this would be quite feasible, it would, on the whole, probably be more

convenient to use if possible a separate purifier through which to pass the gas after it had been through the Quadruplex. A comparatively old small purifier filled with lime would serve well for such purpose and would usually be available.

Revivification of the oxide *in situ* or without removing it from the purifier, where practiced, is usually done probably principally in order to save the labor of shovelling it in and out of the box, etc. In the Quadruplex box where there is so little manual labor necessary—in fact practically none at all—in charging and discharging oxide, there is but little necessity for or object in revivifying *in situ*. A few lids opened, a few wheels turned and the oxide is in heaps on the cellar floor ready to be spread and revived in the open air, either there or in the sunlight nearby, more quickly and to an advantage, I believe, greater than revived within the box. However, if any one using the Quadruplex box desires to revivify *in situ*, there is nothing to prevent it. The usual small per cent. of air may be passed through along with the gas, or a compartment may be thrown out of circuit and revived in the usual fashion. The hopper and charging doors afford convenient air openings in conjunction with suitable steam connections which may be made. Temperatures may be watched by thermometer tubes reaching through the side plates into the oxide at sundry points. Revivification *in situ* develops a tendency to harden the oxide, and if practiced in the Quadruplex box, it would probably be as necessary as it is in ordinary boxes, that the oxide about once in so often be taken out and be well worked or turned over.

In an ordinary box, if during the time the oxide is in use it should be spaded and turned over three times before it is discharged as foul, I think it might reasonably be expected that an increase of efficiency in the amount of gas purified per bushel would be found. If this is so, such increased oxide-efficiency may then be looked for in the operation of the Quadruplex box, for in it between the time of the insertion of fresh oxide and its discharge as foul, the oxide is three times completely turned over and shaken up in being poured from tray to tray. Small channels are destroyed, lumps broken and the particles re-arranged in this process, giving fresh chance for contact with the gas by every bit of the oxide. While experience only will show, and I suggest rather than claim the advantage, I shall be surprised if the efficiency per bushel is not somewhat increased, for the reason suggested.

Details of the Quadruplex box may vary. It may be made of any size and with even five or six layers of oxide or with two layers of sawdust boxes. The shape may vary. The equivalent of ordinary 12x16-foot boxes may fit a given space better and give equal capacity if made 9x22 feet or 10x20 feet, instead of 12x16 feet. The sawdust may be omitted entirely. The depths of the side plates or sections and of the oxide beds may vary. In quite large boxes it would probably be desirable to provide two partitions and six valves, making three compartments, so that while charging oxide but one-third the capacity would be even temporarily out of use, two-thirds always being in circuit. A reciprocating rake arrangement may be used for levelling, instead of the rotating blades. Levelling devices may be used over each bed of oxide. Cranks, rods and levers may be used instead of wheels and worm gears for dumping the trays, etc. The drawings accompanying are not intended to show the only way the box can be built or the various arrangements possible of details. They are merely meant to show the several distinctive features that of one form or another and in combination make up the box.

With the detailed description of its construction and operation as above in mind, let us now summarize the points of the Quadruplex in comparison with the existing customary form of boxes.

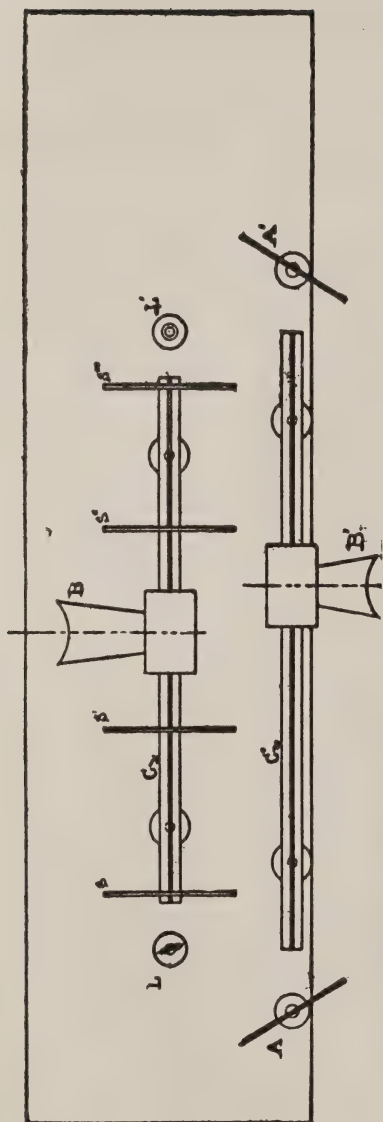
First, Everything that present boxes do can be done with and said of it. The gas, at the same slow rate of speed as at present, passes through successive beds of oxide that may be of any depth desired for purification by contact, as in present boxes. These beds are in rotation removed and revived as they become foul as at present. Tests may be made and pressures noted in the usual manner; sawdust may be used and also lime; revivification *in situ* may be practiced if desired. *In addition*, the following can be said of it: The Quadruplex is so compact that it decreases the necessary floor space nearly two-thirds, or to such an extent that it will often enable a gas company to double its purifying capacity within the space occupied by their present lime or oxide house or shed. Even in this small relative space it affords, if desired, the capacity of four ordinary boxes in use at once, instead of three customarily used.

It reduces pipe elbows and connections by two-thirds and such opportunities for stoppages proportionately. It uses four plain valves instead of a complex valve-system or a centre-seal that is

liable to give trouble. It increases safety by having no open seals, making less chance for the escape of gas and possible explosions. With it, blank walls as fire partitions and sealed-wall lanterns are no more needed than in any of the other departments of the works. It needs no heat in winter for cups. If steam is perchance cut off, no harm is done. It has no wrought-iron covers to rust out, nor accompanying hoisting gears to break or get out of fix, or to involve repair expense. The mechanical construction of the box is upon plain customary lines. The design involves no constant moving parts as in rotary scrubbers, no fast-moving or fast-wearing parts, nor any especially complicated construction or feature. The dumping trays are simple and operate with a plain mechanical movement. The trays themselves are ordinary ones and so arranged that they cannot get lost or easily broken in contrast to ordinary loose movable ones. The scheme of the box is simple and as much within the comprehension of an ordinary workman as the proper manipulation of the present centre-seal and four accompanying separate boxes. The manual effort of operation by the use of the gears is light, and the total labor involved in cleaning a level and renewing oxide is even less than the little necessary at present.

With all of these features and advantages, estimates indicate that the Quadruplex box can yet be constructed and sold at a cost but little if any over that of ordinary boxes. When it is remembered that the building, roof and foundation work necessary is but a half or less of that required for the ordinary form, it will be seen that a gas company, in extending its purifier capacity, can, by using the Quadruplex form, not only secure its advantages, but also do so at an actual less total cost than if extending capacity on ordinary lines.

A principal object of this Association is the discussion of suggested improvements in our business. I submit herewith the Quadruplex form of purifying equipment as described, as an improvement over present purifying boxes, and I ask your candid and friendly criticism upon it.



A and A' Reflecting Screens.
 L and L' Lights.
 S and S' S'' S''' Screens for preventing reflected light from reaching Photometer Disk.
 B and B' Disk Boxes.
 C and C' Photometer Bars.

SOME FURTHER EXPERIMENTS ON INTERIOR ILLUMINATION.

WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY ALLEN S. MILLER.

The paper presented by Mr. Page at our last meeting, giving the result of some novel experiments on the reflection of light by wall papers, gave such results that your Committee on Research concluded to pursue the subject further. This paper was prepared in accordance with the request of that Committee.

On examining the apparatus used by Mr. Page it was apparent that the use of several reflecting surfaces introduced an error the gravity of which could not be estimated, therefore, in continuing the experiment it was decided to use a circular disk in the place of the box. At the suggestion of Mr. A. C. Humphreys, two photometer bars were arranged in parallel 12 inches apart. One was 60 inches long and the other 72 inches. The shorter bar was used to compare the lights directly, the longer one to compare the reflections.

The bar for comparing the light reflected was made longer than the other one so that the reflecting screens might be as nearly normal to the line of the bar as possible. The screws were placed normal to the line bisecting the angle between the 72-inch bar and the line drawn from the centre of the light to the centre of the screen. When a flat flame burner was used it was so placed as to bisect the angle between the photometer disk and the reflecting screen. The reflecting screens were twelve inches in diameter and were so arranged as to be easily interchangeable and to be rotated around a vertical axis. As far as possible the tests were made on lights of equal illuminating power so as to reduce to a minimum any liability to error.

From Mr. Page's experiments it seems that a slight difference in the color of the lights made a great difference in the amount absorbed by the screen and very much less of the light that had

passed through an opal globe than that which had not so passed seemed to be absorbed by the wall paper. The experiments were carried out with the object of ascertaining whether such a difference really existed and, if so, to ascertain its amount.

The method adopted was to compare the lights directly, then to compare the reflections. Afterwards an opal globe was put over one light and it was compared with the other unscreened. The reflections were then compared. After that the globe was changed to the other light and the comparisons made as before. Any great degree of accuracy in comparing such small quantities of light as were reflected from the screens is out of the question and the difference in the color of the lights added to the difficulties of reading closely. Great care was exercised to reduce all errors to as small a degree as possible and the general result may be depended upon as being reasonably accurate.

As the time for making these experiments was limited, and as there was always a single object in view, no attempt was made to elaborate them. Several readings were taken for each result recorded and the photometer screen and the reflecting screens were reversed. The opal globe was revolved and the mean of the readings taken. Several of the results seem to be at variance with what might have been expected and others do not check. No attempt was made to ascertain the reason for this, as the time was short and there seemed enough data to demonstrate that no unusual effort is obtained by passing light through an opal globe and that the light reflected is what may be expected when the color of the paper and the color of the lights are taken into consideration.

PAPER NO. I.

Welsbach light tested against No. 7 Bray slit union.

Direct.—Light from Welsbach= $1.4 \times$ light from slit union.

Reflected.—Light reflected from Welsbach= $1.3 \times$ light reflected from slit union.

Efficiency of Welsbach 94.3 per cent.

Slit union turned down so as to give a flabby flame.

Direct.—Light from Welsbach= $2.8 \times$ light from slit union.

Reflected.—Light reflected from Welsbach= $2.45 \times$ light reflected from slit union.

Efficiency of Welsbach compared to flat flame 87.5 per cent.

Opal globe over Welsbach.

Direct.—Light from slit union= $1.4 \times$ light from Welsbach.

Loss due to globe 74.5 per cent.

Reflected.—Light reflected from slit union= $1.55 \times$ light reflected from Welsbach.

Efficiency of Welsbach in opal globe compared to flat flame un-screened 90.3 per cent.

PAPER NO. 2.

No. 7 Bray slit union and Welsbach.

Direct.—Light from Welsbach= $2.1 \times$ light from slit union.

Reflected.—Light reflected from Welsbach= $1.85 \times$ light reflected from slit union.

Efficiency of Welsbach compared to flat flame 88.1 per cent.

Opal globe over Welsbach.

Direct.—Light from slit union= $1.85 \times$ light from Welsbach.

Loss due to globe 74.3 per cent.

Reflected.—Light reflected from slit union= $2.25 \times$ light reflected from Welsbach.

Efficiency of Welsbach in opal globe compared to flat flame un-screened 82.2 per cent.

Globe over slit union.

Direct.—Light from Welsbach= $7.15 \times$ light from slit union.

Loss due to globe 70.6 per cent.

Reflected.—Light reflected from Welsbach= $6 \times$ light reflected from slit union.

Efficiency 84 per cent.

No. 7 and No. 3 Bray slit unions.

Direct.—Light from No. 3= $1.025 \times$ light from No. 7.

Reflected.—Light reflected from No. 7= $1.05 \times$ light reflected from No. 3.

Efficiency 92.9 per cent.

Globe over No. 3.

Direct.—Light from No. 7= $3.55 \times$ light from No. 3.

Loss due to globe 75.3 per cent.

Reflected.—Light reflected from No. 7= $3.55 \times$ light reflected from No. 3.

Comparative efficiency 100 per cent.

Globe over No. 7.

Direct.—Light from No. 3 = $3.35 \times$ light from No. 7.

Loss due to globe 69.4 per cent.

Reflected.—Light reflected from No. 3 = $3.40 \times$ light reflected from No. 7.

Efficiency 101.5 per cent.

PAPER NO. 3.

No. 3 and No. 7 Bray slit unions.

Direct.—Lights equal.

Reflected.—Light reflected from No. 7 = $1.07 \times$ light reflected from No. 3.

Efficiency No. 3 93.5 per cent.

Globe over No. 3.

Direct.—Light from No. 7 = $3.3 \times$ light from No. 3.

Loss due to globe 69.7 per cent.

Reflected.—Light reflected from No. 7 = $3.3 \times$ light reflected from No. 3.

Efficiency 100 per cent.

Globe over No. 7.

Direct.—Light from No. 3 = $3.5 \times$ light from No. 7.

Loss due to globe 71.4 per cent.

Reflected.—Light reflected from No. 3 = $3.2 \times$ light reflected from No. 7.

Efficiency No. 3 91.4 per cent.

Welsbach and No. 7 slit union.

Direct.—Light from Welsbach = $1.8 \times$ light from slit union.

Reflected.—Light reflected from Welsbach = $1.7 \times$ light reflected from slit union.

Efficiency 94 per cent.

Globe over Welsbach.

Direct.—Light from slit union = $2.15 \times$ light from Welsbach.

Loss due to globe 74.2 per cent.

Reflected.—Light reflected from slit union = $2.30 \times$ light reflected from Welsbach.

Efficiency 93.5 per cent.

Globe over slit union.

Direct.—Light from Welsbach = $5.3 \times$ light from slit union.

Loss due to globe 66 per cent.

Reflected.—Light reflected from Welsbach = $4.7 \times$ light reflected from slit union.

Efficiency Welsbach 88.7 per cent.

PAPER USED BY MR. CARTER H. PAGE, JR., NO. 4.

Welsbach and No. 7 Bray slit union.

Direct.—Light from Welsbach = $1.8 \times$ light from slit union.

Reflected.—Light reflected from Welsbach = $1.5 \times$ light reflected from slit union.

Efficiency 83.3 per cent.

Globe over slit union.

Direct.—Light from Welsbach = $5.1 \times$ light from slit union.

Loss due to globe 64.7 per cent.

Reflected.—Light reflected from Welsbach = $4.55 \times$ light reflected from slit union.

Efficiency 89.2 per cent.

Globe over Welsbach.

Direct.—Light from slit union = $2.23 \times$ light from Welsbach.

Loss due to globe 75.1 per cent.

Reflected.—Light reflected from slit union = $2.1 \times$ light reflected from Welsbach.

Efficiency 106 per cent.

No. 7 and No. 3 Bray slit unions.

Direct.—Light from No. 3 = $1.05 \times$ light from No. 7.

Reflected.—Light reflected from No. 3 = $1.05 \times$ light reflected from No. 7.

Efficiency 100 per cent.

Globe over No. 3.

Direct.—Light from No. 7 = $3.25 \times$ light from No. 3.

Reflected.—Light reflected from No. 7 = $2.9 \times$ light reflected from No. 3.

Efficiency 112 per cent.

Globe over No. 7.

Direct.—Light from No. 3 = $3.55 \times$ light from No. 7.

Loss due to globe 70.4 per cent.

Reflected.—Light reflected from No. 3 = $3.3 \times$ light reflected from No. 7.

Efficiency 93 per cent.

Proportion of unscreened Welsbach light reflected, when compared with light reflected from

No. 7, stiff flame, Paper No. 1.....	94.3 per cent.
No. 7, flabby flame, Paper No. 1.....	87.5 “ “
No. 7, stiff flame, Paper No. 2.....	88.1 “ “
No. 7, stiff flame and globe, Paper No. 2.....	84.0 “ “
No. 7, stiff flame, Paper No. 3.....	94.4 “ “
No. 7, stiff flame and globe, Paper No. 3.....	88.7 “ “
No. 7, stiff flame, Paper No. 4.....	83.3 “ “
No. 7, stiff flame and globe, Paper No. 4.....	89.2 “ “

Welsbach in opal globe compared with

No. 7, Bray slit union, flabby flame, Paper No. 1..	90.3 per cent.
No. 7, “ “ “ stiff flame, Paper No. 2....	82.2 “ “
No. 7, “ “ “ stiff flame, Paper No. 3....	93.5 “ “
No. 7, “ “ “ stiff flame, Paper No. 4....	106.0 “ “

No. 3 Bray slit union compared with

No. 7, Bray slit union, Paper No. 2.....	92.9 per cent.
No. 7, “ “ “ and globe, Paper No. 2....	101.5 “ “
No. 7, “ “ “ Paper No. 3.....	93.5 “ “
No. 7, “ “ “ and globe, Paper No. 3....	91.4 “ “
No. 7, “ “ “ Paper No. 4.....	100.0 “ “
No. 7, “ “ “ and globe, Paper No. 4....	93.0 “ “

No. 3, Bray slit union, screened with opal globe, compared with

No. 7, Bray slit union, Paper No. 2.....	100 per cent.
No. 7, “ “ “ Paper No. 3.....	100 “ “
No. 7, “ “ “ Paper No. 4.....	112 “ “

Average loss due to globe.

No. 7, 68.8 per cent.

No. 3, 71.5 per cent.

Welsbach, 74.5 per cent.

Per cent. efficiency compared with No. 7 burner burning with stiff flame.

OPAL GLOBE. UNSCREWED.

Paper No. 1, Welsbach.....		94.3
Paper No. 2, Welsbach.....	84.0	88.1
Welsbach, with opal globe...		82.2
No. 3 slit union	101.5	92.9
No. 3 slit union, with opal globe		100.0
Paper No. 3, Welsbach.....	88.7	94.4
Welsbach, with opal globe....		93.5
No. 3 slit union	91.4	93.5
No. 3 slit union, with opal globe		100.0
Paper No. 4, Welsbach.....	89.2	83.3
Welsbach, with opal globe ...		106.0
No. 3 slit union	93.0	100.0
No. 3 slit union, with opal globe		112.0

REPORT ON BURNER STOPPAGES.

WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY PAUL DOTY.

The fact that a number of gas companies, our own included, have suffered serious loss in dollars and in prestige from what are known as burner stoppages, leads to the presentation of this report, giving the results of our experience, including experiment and research, in the effort to discover the cause and cure of these troublesome deposits.

By burner stoppages we mean the phenomenon of the formation and growth of the curious deposits on burner tips, often assuming tree-like shapes, trunk and branch, sometimes called "Christmas trees," which, when formed, choke the opening in the tip, spreading and deflecting the flame and much reducing the efficiency of the burner, consequently impairing the lighting effect. Incident to the spreading of the flame comes the breaking of globes, threats of claims and damages and the thousand and one comments which those who have passed through the bitter experience have still a sorrowful remembrance.

The cause of these growths was for a more or less extended period an unknown quantity. Since physical examination showed carbon or coke to be present as the principal part of the deposit, it was believed carbon was the disturbing element. Dr. E. G. Love writes in the *Journal of the Society of Chemical Industry*, Vol. 12, May, 31. 1893, p. 433, under the caption "Carbon Deposits on Gas Burners," that "these growths are composed practically of pure carbon; they are entirely consumed on ignition, and are free from iron, which would not be the case if iron carbonyl had a part in their formation." Dr. Love explains in his article the phenomenon of the growth of these deposits, and illustrates some of the effects. The statement quoted above leads to the query whether iron be not present, for Dr. Love admits "up to the present time (1893) I have

not been able to find any satisfactory explanation for this formation of the curious growths," and further "the immediate cause of the deposit is the dissociation of hydro-carbons at the high temperature attained in the steatite tip, and is doubtless similar to the deposition of carbon in the retorts used for 'fixing' the naphtha vapors. This, however, does not explain the conditions necessary to the formation."

President Morton writes in the *Stevens Indicator* for January, 1896, p. 23, on "Gaseous Compounds of Iron and Nickel with Carbonic Oxide and Their Curious Effects on Burner Tips," etc.: "It was naturally supposed that these deposits consisted of some variety of coke or like carbon compound, but to make sure, some of them were sent to Dr. Durand Woodman, of New York, for analysis, and when his report came in that the material was oxide of iron, it was at first supposed that some mistake had been made, as it seemed incredible that iron in any way should have reached the burner tips or entered into the formation of these excrescences." Dr. Woodman's investigation was made for the United Gas Improvement Co., and by the courtesy of the company I give Dr. Woodman's analysis of his examination of the burner stoppage deposits submitted to him:

Sulphuric Acid.....	0.23%
Residue on ignition 1.30% :	{
.....	{ Iron Oxide 0.79%
.....	{ Silica 0.51%
Moisture and loss dried at 110° C.....	1.58%
Carbon by difference.....	96.89%
	100.00

Dr. Woodman comments on these deposits as follows: "They were hard and with a velvety appearing coat of lamp black, the end showing the 'pilot wires,' between which and the lamp black coating was an uncovered space of graphitic carbon. The largest of these pieces weighed a little over one-half grain, and the average weight of twenty was 0.29 grain."

Dr. Woodman supplements his analysis with the following appendix:

"There are some points in connection with this stoppage question which suggest that while Iron Carbonyl may be and probably is the determining cause, there is some other chemical condition which accompanies it.

"For example, in 1888 and in 1892 the testimony agrees on the point that difficulty is experienced in maintaining candle power when the trouble is on.

"It does not appear possible that enough Iron Carbonyl could be formed from a few boxes of oxide to affect the candle power of the gas, either by its presence or by its decomposition at the burner; nor that its decomposition should result in the separation of such a quantity of carbon.

"According to the work of a German chemist, Guntz, quoted in Jr. Soc. Chem. Ind. 11/30/92 p. 909; CO exerts an oxidizing action between 212° F. and 600° F. and a reducing action from about 600° F. to a red heat.

"Lowthian Bell has shown that when oxides of iron, nickel or cobalt are reduced by CO, *carbon is always set free.*

"It appears to me that the presence of iron from the decomposition of Fe (CO)₅, may result in a continuous oxidizing and reducing process, whereby free carbon accumulates because of its great stability at comparatively high temperatures, even in presence of air.

"It is a well-known fact that the presence of a small amount of some third substance will in certain cases induce a reaction ('catalytic'), in which it seems to take no active part, or at least no self-destructive part, and there is no doubt left in my mind but that such a reaction accounts for the large deposit of carbon on the burner tips.

"Guntz further states, that in passing CO over metallic iron, finely divided, Iron Carbonyl results at moderate temperatures; FeO and free carbon at higher temperatures. and at still higher, CO₂ in small amount is formed as a product of partial reduction of the FeO by CO.

"I believe that these facts and reactions are the basis for a complete explanation of the formation of Burner Stoppages."

The result of this investigation showing that the deposits contained oxide of iron in part, led to an extended comparison of observed results, the United Gas Improvement Co. leading in the work, and the question resolved itself into "where the iron came from and how it got to the burner tips."

President Morton writes that "extended comparison of experience among many companies showed that the deposits on burner tips were only formed where iron oxide was used in the

process of gas purification. Further observation also developed the fact that this formation of deposits at the burner tips was not uniform nor constant, but varied with the condition of the iron oxide in the purifiers, and was prevented when a thorough oxidation of the iron had been secured, but was notable whenever any reduced or metallic iron was present in the mixture."

President Morton then speaks of the use and preparation of iron oxide, which "in this country is usually prepared from metallic iron in the shape of 'iron turnings' (borings), by exposing them mixed with sawdust to the air, and sprinkling from time to time with 'ammoniacal liquors,' or treating with a solution of 'copperas' or sulphate of iron. In this treatment there was a risk that the iron would not be thoroughly oxidized, and that some metallic iron would be present when the so-called oxide was placed in the purifiers. As soon, however, as it was perceived that the troublesome deposit was connected with imperfect oxidation of the iron in the purifiers, the remedy was easily applied by simply making sure that the oxidizing treatment was continued long enough to secure a thoroughly oxidized product."

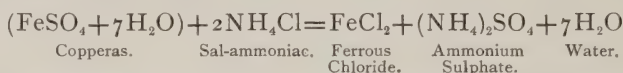
In this connection President Morton having pointed out the importance of having the iron in a thoroughly oxidized condition, it has been suggested a description of the method of manufacture of oxide original with the writer while at Paterson, and further developed at Long Branch, would be of interest.

The introduction of oxide of iron at the Paterson works was undertaken in the winter season of 1890-91, almost as a necessity to overcome the injurious effects caused by the use of a sulphurous coal in the manufacture of the gas. Before this time hydrated oxide of lime had been used successfully and at a not excessive cost. The excess of sulphur in the coal received at this time made the cost of purification by lime almost prohibitory; yet such are the requirements of the service in Paterson, owing to the silk mills, that gas containing sulphuretted hydrogen cannot be burned without attendant loss and damage. The sulphuretted hydrogen burning to sulphur di-oxide, which becomes in the moist atmosphere of the silk dye-house sulphurous acid, destroys the dyes and dyed material.

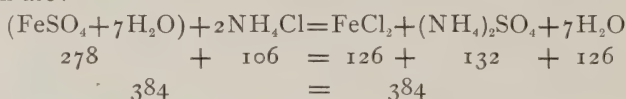
It was at first attempted to make oxide from metallic iron, treated with a solution of commercial copperas and sal ammoniac. As a result of the use of this material it became apparent there was

little real oxide of iron in the mass. A little study will show there was no direct cause for the formation of oxide of iron.

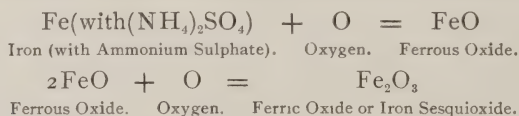
The reactions between commercial copperas and sal-ammoniac are expressed as follows:



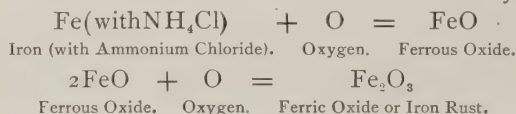
The relative proportions by weight equivalent for a chemical reaction are:



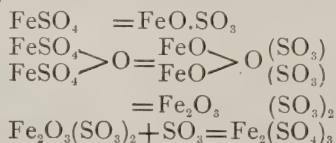
or for every 1 lb. of commercial copperas there should be $\frac{106}{278}$ or nearly $2/5$ lb. of sal-ammoniac. Still by this reaction we evidently do not form oxide of iron from the copperas, but do form ammonium sulphate, and moistened metallic iron in the presence of an ammonium salt as ammonium sulphate or ammonium chloride will absorb oxygen from the atmosphere, forming ferrous oxide, FeO, which further absorbs oxygen passing into the higher oxides:



This reaction can also take place in the presence of ammonium chloride, as is well known in the formation of iron rust joints:

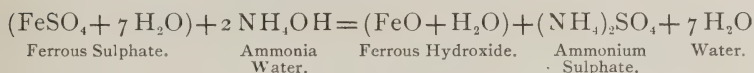


Ferrous sulphate or copperas also easily takes up oxygen, like all other ferrous compounds, forming an oxidized sulphate of iron which, when acted upon by sulphuric acid, forms ferric sulphate. This is noted when blue (green) vitriol becomes coated with brownish spots on exposure to the atmosphere. This substance will also absorb sulphuretted hydrogen. The formation of the substance is shown by the reactions :



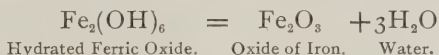
The small amount of real oxide of iron present in the first mixture led me to study some means of forming oxide of iron, and as a result in June, '91, 900 bushels of new material were made, in which the sal-ammoniac was used to oxidize the iron alone, and ammonia water was used to oxidize the copperas.

The reactions for the copperas are



This precipitate is partly prevented by ammonium chloride.

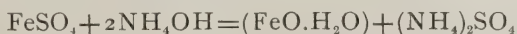
The precipitate rapidly absorbs oxygen from the atmosphere, becoming reddish brown hydrated ferric oxide $\text{Fe}_2(\text{OH})_6$



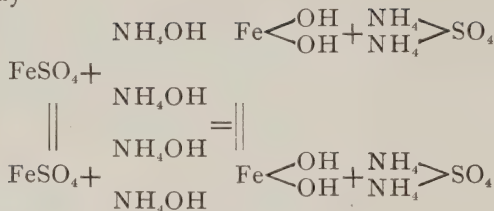
Long exposure to the atmosphere and much wetting with water has converted by this time much of the iron used in the first mixture to the condition of iron rust, so that when the new mixture was added and the whole mass tried, it was found to be successful in removing the sulphuretted hydrogen of the gas with economy and safety. The mass would on exposure to the atmosphere upon removal from the boxes rapidly regain its naturally brownish color, a very good proof of the real oxide of iron. A complete absence of burner stoppages during this period of the introduction of real oxide of iron, would seem to indicate that burner stoppages do not result from the use of oxide of iron.

In February, 1892, the mass having become somewhat dense by use, it was considered advisable to make some new oxide of iron from copperas; this new oxide of iron and wood shavings being mixed with the old mass to lighten the total weight per bushel. Wood shavings alone would have served as well for reducing the weight of the mass per bushel, but for the purpose of investigation and experiment copperas was used. The method pursued and the reactions are given below. I believe it is better (safer) to use oxidized copperas for the preparation of oxide of iron, rather than the commercial copperas which was used in June, '91. The reason is shown by comparing the reactions.

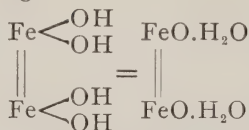
The reactions given above for commercial copperas, ferrous sulphate were, omitting the water:



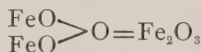
or to amplify



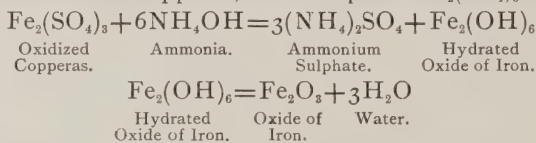
By combining



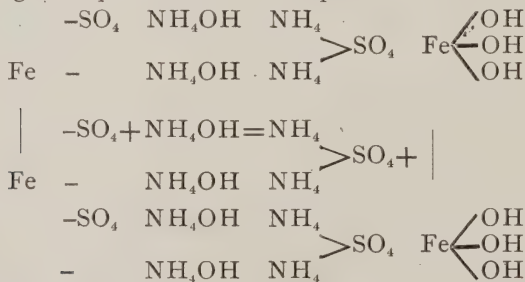
or we have only the ferrous hydroxide which needs oxygen to become ferric oxide—



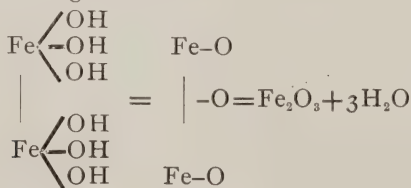
If we use oxidized copperas, ferric sulphate $\text{Fe}_2(\text{SO}_4)_3$ we have



Amplifying the equation for ferric sulphate—



and by combining we have



or we now have ferric oxide of iron.

As shown above, the ferric oxide is in the condition of hydrated ferric oxide, and it is in this condition when it is most valuable for absorbing sulphuretted hydrogen.

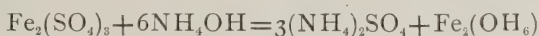
To make oxidized copperas, ferric sulphate, $\text{Fe}(\text{SO}_4)_3$ we have

$6(\text{FeSO}_4 + 7\text{H}_2\text{O}) + 3\text{H}_2\text{SO}_4 + \text{KClO}_3 = \text{KCl} + 45\text{H}_2\text{O} + 3\text{Fe}_2(\text{SO}_4)_3$
Commercial Copperas. Sulphuric Chlorate Potassium Water. Oxidized
Acid. of Potash. Chloride. Copperas.

or for proportion we have

$$\begin{aligned}
 6(\text{FeSO}_4 + 7\text{H}_2\text{O}) + 3\text{H}_2\text{SO}_4 + \text{KClO}_3 &= \text{KCl} + 45\text{H}_2\text{O} + 3\text{Fe}_2(\text{SO}_4)_3 \\
 6(278) + 3(98) + 122 &= 74 + 810 + 3(400) \\
 1668 + 294 + 122 &= 74 + 810 + 1200 \\
 2084 &= 2084
 \end{aligned}$$

The final reactions for the formation of the oxide of iron are given again:



From the two equations can be derived the proportions by weight of the materials used to make hydrated ferric oxide from copperas.

It will be noted that in the above, metallic iron is not considered. In the preparation of entirely new lots of oxide metallic iron must necessarily be used to lengthen the life of the mass. Metallic iron is converted into oxide as shown above by the use of an ammoniacal salt, such as ammonium chloride; 1 oz. of sal-ammoniac is sufficient for 20 lbs. metallic iron, the oxygen being absorbed from the atmosphere; sufficient time (say three weeks) should be allowed for complete rusting. The final mass is made by mixing the moistened oxide of iron made from iron with the hydrated ferric oxide made from copperas, together with sufficient wood shavings wet with water to have the material weigh when first made, about 50 lbs. per bushel.

A total of 1,600 bushels of iron oxide was prepared at Paterson by the above method and used with success, in that during the period of its introduction no burner stoppages resulted, and the sulphuretted hydrogen in the gas was completely and cheaply removed. In 1895 this oxide contained nearly 40 per cent. by weight of sulphur.

In 1897, 1,100 bushels of new oxide were made by this method at Long Branch, and put in use in the purifiers with no complaints of burner stoppages. In the summer of 1896, 2,500 bushels of a commercial oxide had been purchased, and from the use of this

oxide came the disastrous results mentioned in the introduction of this report. In purchasing the sponge, especial stress was laid on the necessity of having the iron thoroughly oxidized, and nearly four months elapsed from the date of the order to the delivery of the sponge. The material when received was unsatisfactory, in that the mass contained unoxidized iron, and every effort was made locally to oxidize the iron by the use of salt water for over a month. It was believed the material could then be used with safety, and acting on this belief, the material was put in the purifiers. With surprising promptness came disastrous results. Complaints of burners stopped and poor light brought many an anxious care to all at interest. The memory turns to that dark period with sad retrospect. With the disaster full upon us, the efforts of all were exerted to remove the cause, already well known, and to minimize the effect. The material was at once removed from the purifiers, box after box, and saturated with commercial ammonia water, and frequently turned to expose all unoxidized iron to the oxygen of the atmosphere. Salt water is effective but slow; ammonia water or an ammoniacal salt water is effective and quick. When the oxide was replaced in the boxes, the material was covered with burlap or coarse cloth, on which was spread a layer 3 inches thick, of clay and loam. Lime has been used also, but clay was found quite as effective. What virtue there is in clay, I am not prepared to state but it is believed the use of clay was of good effect in preventing further stoppages. Bowditch, in his work on "Analysis, Purification, Etc., of Coal Gas," p. 24, writes, "In 1854, I introduced the use of clay as a purifier, first and principally to remove ammonia without damaging the light-giving constituents of the gas, and secondly, to remove sulphur compounds which other processes failed to effect. Clay removes ammonia from gas as perfectly as acids and metallic salts do. The use of clay does not destroy any of the illuminating constituents; it has a remarkable power of acting upon certain sulphuretted compounds in gas, so as to render them removable." A precedent is thus shown for the use of clay in the purifiers, but no explanation of why it is effective.

The treatment with ammonia water and the use of clay removed the cause of the stoppages, by reason of the now thorough and complete oxidizing of the iron.

The tips in use at the time of the trouble were the regular E. H. lava slit type, and stopped with remarkable quickness. Experi-

ments were made to find a tip less subject to stoppages, to minimize the effect of the iron, with the result that the Bray union jet was adopted as the tip least affected. These experiments were made by my former assistant, Mr. Tuttle, and from his report I note in the test of the Bray union jet burner compared with a lava slit tip, where gas was passed through iron filings at the rate of .75 cubic feet per hour, at the end of 96 hours, the Bray tip was still burning clear, while the slit tip which had begun to choke inside of 48 hours was noted giving a streaked and ragged flame under moderate pressure. Mr. Alfred Forstall's paper, read before this Association, reported in Vol 10, pp. 94-97, gives a table of comparative values of different burners, and while the Bray union jet shows comparatively less efficiency than the slit burners, on p. 95, he mentions what our experiments confirm, the property which the union jet has "of not stopping up, which may, under certain conditions, compensate for its lower efficiency." These conditions are surely present when stoppages are general, and, in that event, I recommend the use of the union jet burner.

The subject of burner stoppages, while, perhaps, well known, and much discussed by comparison of experiences, has little heretofore printed literature. I find in the *American Gas Light Journal*, for May 2, 1887, p. 280, a report of the meeting of the Ohio Gas Light Association, where Mr. Eugene Printz read his paper on the "Causes and Prevention of Stoppages in Burner Tips." Mr. Printz gives as a cause for the stoppage of the burners, the presence of bisulphide of carbon. "We have here then, not only a cause for the stoppage of the burners, but a reason for the sulphur fumes that are complained of at times. The carbon of the bisulphide being deposited, the sulphur unites with the hydrogen, to pass through or from the burners as the sulphide of hydrogen. Mr. Printz suggests the precaution "to take out or decompose the bisulphide before the gas enters the lime or oxide of iron purifiers. As a suggestion, let the gas be passed through an iron retort filled with a loose clay material, heated to about 500° temperature by utilizing the waste heat from the furnace. It is not likely, in this case, there would be a recombination of the hydrogen with carbon, and sulphur dropped as pure sulphur, or possibly a monoxide of carbon would form, which, while not a light producer itself, might be useful as a heat producer, and thus have a tendency to increase the illuminating power of the gas."

This subject was raised again in the question box of the Ohio Gas Light Association, by the question: "What is the cause of the lava tips fouling when the gas shows clean by the usual test?" The question was discussed by Mr. Faux, Mr. Printz, and the President, Mr. Faben, and the reason assigned to the presence of bisulphide of carbon, which, however, was not considered conclusive.

It is believed bisulphide of carbon is present in minute quantities, if at all, in carburetted water gas, and burner stoppages have been most prolific with this kind of gas. Bisulphide of carbon is believed, therefore, not to be the determining or chief cause of the stoppages. Mr. Printz gives unknowingly, perhaps, a means for the removal of iron carbonyl, the real cause; unknowingly, for in 1887 iron carbonyl had not been discovered, by suggesting the passage of the gas through a heated retort, for as we now know, iron carbonyl is decomposed at a temperature below 500° into carbon monoxide and iron.

The application of heat, in purification, dates back much further than the above, for the *Quarterly Journal of Science*, London, for July, 1872, p. 396, mentions a method by which coal gas can be readily freed from sulphur, namely, "by heating the gas to redness when the sulphur will combine with hydrogen to form sulphide of hydrogen, which can be easily removed by passing through a purifier containing oxide of iron. When coal gas, containing 30 grains of sulphur in 100 cubic feet, was passed first through a red hot tube, and then through an iron purifier, the sulphur was reduced to 5 or 6 grains. The heat did not injure the quality of the coal gas, as by passing gas of 14.91 C. P. rapidly through a tube heated to dull redness, the illuminating power was found to be 15.1 C. P., and a still hotter tube increased the light to 16.66 C. P."

Our trouble with stoppages having been overcome with the oxidizing treatment of the iron, and our consumers satisfied with burner tips that did not require too frequent renewals, our experiments led us to investigate the subject of the presence of the iron in the gas.

The discovery of iron carbonyl was made in 1891, independently, by M. Berthelot and Messrs. Mond and Quincke. M. Berthelot communicated to the *Comptes Rendus*, 112, 1343-1349, reported in the *Journal of the Chemical Society*, Vol. 60, 1891, p. 1427, under the title, "A Volatile Compound of Iron and Carbonic Oxide,"

also reported in the *London Journal of Gas Lighting*, September 1, 1891, under "Iron Carbonyl," a statement of the results of working with carbonic oxide, whereby he has obtained a new compound of this oxide and iron.

Metallic iron reduced from a precipitated ferric oxide at the lowest possible temperature, or from ferrous oxalate by heating and subsequent completion of the reduction in hydrogen, is acted on by carbon monoxide, at a temperature of 45° C., the gas after passing over the iron, containing sufficient iron to cause it to give a brighter flame than is usual. The flame has a characteristic spectrum, and deposits iron (partly oxidized) upon a piece of porcelain thrust into it. On passing the ferruginous gas through a narrow heated tube, a ring of iron containing a little carbon, is deposited. The metallic mirrors formed in this way are readily soluble in dilute hydrochloric acid; the solution affording the ordinary reactions for iron. M. Berthelot expects that this discovery will prove of great practical importance. He calls the new compound "iron carbonyl."

In the *Journal of the Chemical Society*, 1891, Vol. 59, p. 604, Mond and Quincke published a paper entitled, "Note on a Volatile Compound of Iron and Carbonic Oxide." President Morton, in the *Stevens Indicator* for January, 1896, refers to the article, also to the account published in the transactions of the British Association for the Advancement of Science, 1891, p. 602. Mention is also made of these experiments in the *Journal of the Society of Chemical Industry*, Vol. 10, 1891, p. 644. President Morton writes that Mond and Quincke "relate how they have succeeded in forming a compound indicated by the formula $\text{Fe}(\text{CO})_5$, which is produced by admitting carbonic oxide to carefully prepared, finely divided metallic iron at the ordinary temperature of the laboratory, when the gas is absorbed by the metal. When this action has continued for 24 hours, the vessel containing the iron is heated to about 120° C., when the compound $\text{Fe}(\text{CO})_5$, or iron carbonyl distills off, and is condensed in a freezing mixture at -20° C. as a somewhat viscous liquid of a pale yellow color. Its specific gravity at 18° C. is 1.4664. It distills without decomposition at 102.8° C. at 749 mm. pressure, and solidifies below -21° C. into a mass of yellowish needle shaped crystals. It is soluble in alcohol, benzene and like solvents, and at 180° C. is entirely decomposed into iron and carbonic oxide. Its vapor density is 6.4."

The *Journal of Gas Lighting* for December 1, 1891, under "Iron

Carbonyl in Coal and Water Gas," relates how Sir H. Roscoe found iron carbonyl in carbonic oxide, which had been stored in an iron cylinder; and he expressed the opinion that it is the cause of the red deposit found upon steatite gas burners. Further mention is made of "The Metallic Carbonyls" in the *London Journal* for June 28, 1892. In *Progressive Age* for November 1, 1892, under "Iron in Gas," I note: "At the November meeting of the Chemical Society, a paper of considerable interest was presented by Sir Henry Roscoe and Mr. Scudder on the action of water gas upon iron, says the *London Gas World*. On the occasion of certain experiments on the use of water gas, with Fahnehjelm's combs, it was observed that when the gas had impinged upon the comb for some hours, iron oxide had become deposited on the magnesia, and had materially diminished the lighting power. The iron was in the water gas itself, and could not be filtered out by cotton wool; it was, therefore, present in a volatile form. In another series of experiments, water gas was stored in a steel cylinder at 8 atmospheres pressure. If the gas were used immediately, there was no change in the color of the flame or in the composition of the gas; but if it remained stored for a month, the flame produced by means of a steatite burner was brightly luminous, and a Fahnehjelm comb was at once covered with a yellow coating of iron oxide, showing that the gas contained much more iron than at first. If the gas were led through a gas combustion-tube, and this tube heated, a black metallic mirror was deposited, consisting of iron free from carbon, arsenic or antimony. If cotton wool were put between the jet and the place where the mirror was deposited by heat, the flame was non-luminous, while the cotton wool was blackened. A porcelain slab put in the luminous flame became covered with a film of iron or of iron oxide.

"The weight of iron, deposited in the form of a mirror, and upon the cotton wool, corresponded to 2.4 milligrams of iron per litre of gas, or to a little over 1 grain per cubic foot. The water gas used contained 39 per cent. of carbonic oxide. The volatile iron compound was, no doubt, the iron carbonyl of Mond and Quincke, and was easily condensed on passing the filtered gas through a U-tube cooled by ice. Ordinary coal gas contains some carbonic oxide, and this causes it to take up traces of iron, which is the cause of the superficial deposit upon steatite burners. Dr. Thorne said that he had found compressed coal gas stored in a

steel cylinder to contain iron. He had been led to inquire into this by finding that the lime cylinder of his lime light was sometimes covered with a brown deposit.

"In Nancy, M. Guntz has recently been working at the same subject. He found that the gas burners became coated after 40 to 100 hours, with a deposit which was at first white, then rose-colored, and finally red. He also found that iron oxide was deposited on all objects long exposed to the products of combustion. He concluded that Nancy gas must contain iron in a volatile form, probably Mond and Quincke's iron carbonyl produced by the action of carbonic oxide on finely divided iron. In Nancy, iron is added to Laming's purifying mass, in the form of filings; these are first converted into sulphide by the moist air and free sulphur, and this becomes oxidized into oxide of iron. But before this occurs, the excess of metallic iron and the 4 to 5 per cent. of carbonic oxide in the gas may act on one another and form the iron carbonyl."

The *London Journal* for January 10, 1893, refers also to M. Guntz's communication respecting the probability of the presence of iron carbonyl in coal gas. This hypothesis is supported by the act, vouched for by M. Guntz, that in a town on the outskirts of the city of Nancy no ferruginous deposits of the kind described were perceived before the local gas works began to use the purifying mass before mentioned. A few days after the change had been made, the lamp glasses became reddened by deposits of oxide of iron.

Co-incident with our stopped burners, our Welsbach mantels became stained with the reddish deposits of oxide of iron and on this point I note from the *London Journal* for March 20, 1894, "all these incandescent burners show a marked deterioration in lighting power after being some hours in operation with water gas; the Auer mantels which retain their efficiency the longest, requiring replacing after 200 hours' use. This rapid deterioration is due to a deposition of a film of oxide of iron on the surface of the mantel. It has been proved this deposition of oxide is due to the presence in water gas of iron carbonyl— $\text{Fe}(\text{CO})_5$ —the compound discovered a few years since by Mond. It is, therefore, satisfactory to have discovered a method of removing the iron compound from the gas. Heating the gas to a temperature of decomposition of the carbonyl appeared impracticable; but it was found that concentrated sulphuric acid completely and rapidly absorbed

the iron compound from the gas. A small cylindrical revolving scrubber was constructed of lead, with lead baffle plates within, and used, when half filled with strong sulphuric acid, to purify the water gas. About 3,500 cubic feet of gas was purified by from 2 lbs. to 3 lbs. of sulphuric acid; and the waste dilute acid was not valueless. The water gas so purified did not produce a deposit on burning; and an Auer mantel was found to last upwards of 400 hours without appreciable diminution in its power of emitting light. The passage through the sulphuric acid appeared to have increased the efficiency of the gas. With this preliminary purification therefore, water gas seems well fitted for use in an incandescent system of lighting."

The water gas referred to above will be at once recognized as uncarburetted water gas, the use of which has not found adoption to any considerable extent. Butterfield's Gas Manufacture, p. 136. speaks of the necessity of the removal of iron carbonyl, contained in small quantities in cold water gas. "This compound causes a deposit of iron oxide on the mantels or combs used for emitting light, and rapidly reduces their efficiency. It has been proposed to remove the iron carbonyl by passing the gas through strong sulphuric acid, or by heating it to a red heat at a point near the place of combustion, and H. Strache, of Vienna, has patented schemes for purifying water gas by these means in Germany." The *London Journal for Gas Lighting* for March 27, 1894, notes, "that Herr H. Strache, of Vienna, has patented in Germany methods for the removal of the iron compound which causes the troublesome deposition of iron oxide on the mantels of incandescent burners consuming water gas. He mentions in the specifications the method of washing the gas with acid, and also the decomposition of the iron carbonyl by passing the gas through red hot tubes, a plan he considered impracticable at the time of writing his paper. By the first process the iron carbonyl is converted into a soluble salt by the acid; by the second, the iron is deposited in the heated tubes." The *London Journal* for July 13, 1897, p. 111, notes again Herr Strache's patent for removing gaseous iron compounds from water gas. This invention, under date of July 31, 1896, "relates to apparatus enabling the water gas to be purified by bringing it into contact with concentrated sulphuric acid, over as large a surface as possible—first drying the gas by the acid, which runs away after having served for taking up the iron."

The removal of iron carbonyl from carburetted water gas by sulphuric acid cannot safely be done except in special cases where the gas is used for fuel exclusively. Sulphuric acid removes the hydrocarbons as well as the iron, and thus destroys the value of the gas as an illuminant. Removal by heating is impracticable on a large scale, but this method can be used in the laboratory for quantitative analysis of the gas for iron carbonyl. A number of such analyses have been made at Long Branch by Mr. Tuttle, who writes in his report, "the presence of iron carbonyl may certainly be determined by passing a quantity of gas slowly through a glass tube heated above 180°C. , and then washing out the tube with aqua regia, diluting the acid with water, adding ferrocyanide of potassium and heating when, if there be any iron present, a light blue color will be formed, which soon turns into a deep blue; or if the acid be neutralized by ammonia water and ammonium sulphide added, the iron if present, will come down at once in a dark precipitate. This test may be made quantitative by using a measured volume of gas and a tube long enough to insure a complete decomposition of the iron carbonyl and then burning and weighing the precipitate brought down by ammonium sulphide. A bath of boiling cylinder oil (above 300°C.) may be conveniently used with a U-tube to obtain a steady sufficiently high temperature."

Results of two quantitative analyses show 500 milligrammes and 485 milligrammes, or 7.5 grains per 1000 cu. ft. gas. It will be noted these quantities are only $1/140$ of the amounts reported in the *Progressive Age*. The experiments we report were made in January, 1897, at a time when the gas gave no trouble with burner stoppages. The quantity would be much greater, therefore, when stoppages were prevalent. From these experiments we believe that iron carbonyl is always present to a greater or less extent in water gas, owing to the carbon monoxide present and its affinity for metallic iron, not only the iron in the purifiers, but the iron of the mains. The presence of hydrogen also assists in the formation of iron carbonyl. In this connection the formation of carbonyl may come from another source, viz., the admission of oxygen or air to the purifiers for revivification of the oxide of iron *in situ*. It is stated by Fenton, Notes on Qualitative Analysis, p. 25, that "sulphides heated in a current of air (oxygen) evolve sulphur dioxide." This statement is significant for if $(\text{FeS} + \text{O}_2 = \text{Fe} + \text{SO}_2)$ iron sulphide and oxygen form sulphur dioxide, free iron is libera-

ted and two constituents of the gas become possible sources of danger. A comparison of experiences of companies using "nitrogenated oxygen" in purification and having burner stoppages would be of interest.

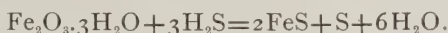
Iron carbonyl opens up a new field for investigation and this report prepared at the request of your Research Committee, is submitted to present the subject. Iron carbonyl is somewhat analogous to naphthaline, in that I believe it is always present in a greater or less degree in either kind of gas. The secret of success with naphthaline is to hold it in suspension in the gas until the burner is reached, where it is valuable as an illuminant. With iron carbonyl the gas should carry it past the burner, so that the iron formed by decomposition is dissipated in the air surrounding the flame.

CHEMICAL NOTES ON PURIFICATION,

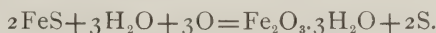
WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY HENRY A. MATHER.

Before considering methods of chemical treatment of iron purifying materials, a review of the various formulas of the reaction between sulphuretted hydrogen and hydrated oxide of iron, is pertinent to a better understanding of this especial department of gas making.

The familiar King's Treatise (1) uses the formula $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ to express the hydrated oxide of iron, and combining one molecule of this hydrate with three molecules of hydrogen sulphide produces the equation:—

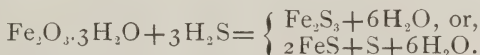


Regeneration is expressed by—

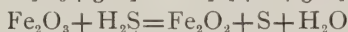
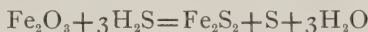


These equations have been accepted by many technical and chemical writers, evidently without investigation.

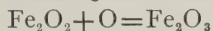
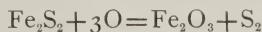
Edmond Borias in his Treatise on Gas Manufacture (2) writes the equation—



Mr. Wm. Mooney (3) differs from these eminent authorities, showing the absorption of sulphuretted hydrogen as follows:—



He expresses regeneration by the equations



It is difficult to account for this theory on any grounds, especially as he says that the "second equation in each case is probably

(1) King's Treatise on Coal Gas, Vol. II, Part IV, Chap. III, pp. 17 and 18.

(2) *Traité de la Fabrication du Gaz*, par Edmond Borias. Edition 1890, pp. 282 and 283.

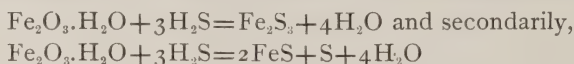
(3) American Gas Engineer and Superintendent's Handbook. Edition 1888, page 80.

the more correct." The water of hydration is omitted for the sake of convenience.

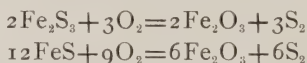
Another technical writer contends that using Laming's mass the carbonic acid gas having greater affinity for the oxide of iron unites with it in the purifying box, the sulphuretted hydrogen combining with the lime. In revivification the carbonic acid goes off into the air in the most accommodating fashion.

As all of these equations require the formula $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ they are of little practical value for there is no such hydroxide in use for gas purification at present, for hydrated sesquioxide of iron loses part of its water of hydration unless it is kept under water. The hydroxide prepared from copperas when freshly precipitated is chemically expressed by $\text{Fe}_2\text{O}(\text{OH})_2$, and bog iron ore is $\text{Fe}_2\text{O}(\text{OH})_2$. The hydroxide prepared from borings is probably the same as bog ore.

Perhaps the most authoritative reaction is that given by Mr. W. J. A. Butterfield (4) in his Chemistry of Gas Manufacture, thus:—



Quoting Mr. Lewis T. Wright (5) he continues "that from 17 to 30 per cent. of the sulphuretted hydrogen is taken up in accordance with the second equation and the remainder in accordance with the first." Mr. Butterfield expresses revivification by:—



Sulphuretted hydrogen or hydrogen sulphide undoubtedly combines in other forms with the hydroxide of iron, but these reactions are the major ones. Hydrogen sulphide is a feebly exothermic compound, but its combination with the hydroxide produces no rise in temperature, on account of the small percentage present and the large condensing surface of the third box as well as the contact with the separated water of hydration which undoubtedly absorbs much of the heat of the gas as well as the heat of combination.

A few years ago little attention was paid to the state of hydration of the iron, and sawdust was used as the only diluent because of the greater surface exposed to the gas. Sawdust possesses more disadvantages than advantages however, because in a layer

(4) Gas Manufacture. W. J. Atkinson Butterfield. Ed. 1896, pp. 90 and 96.

(5) Journal Chemical Society, 1883, p. 156.

of more than 16" in depth it seldom does good work, the back pressure incident to the fouling of any oxide necessitating a change before it is wholly saturated. With a deeper box the space lost between the trays more than balances the advantage of extra surface. The diluent in most general use to-day is planer chips, for the chips combine decreased weight with greater strength. The porosity of such an "oxide" remains scarcely impaired until the oxide is fouled and the purifying box may be filled to its capacity without trays.

The purifying value of a bed of oxide depends on the percentage of hydrated oxide present, the state of division of that hydroxide, and the ability of the bed to keep its porosity. The percentage of metallic iron originally mixed is scarcely a proper consideration unless the iron is wholly oxidized. It is not necessary that more than sixty per cent. of the iron should be hydrated, but any metallic iron present should be at least coated with oxide so that burner stoppage may be avoided.

A recent German writer claims that the rate of progression of foul gas through oxide should not be more than one-fifth of an inch per second. Mr. J. A. P. Crisfield (6) has reduced the calculation of the necessary purifying surface based on the make of gas per hour to a convenient formula for ready reckoning, so that gas companies contemplating extensions are not obliged to consult experts before placing their contracts.

I wish to direct the attention of those superintendents who are hampered by limited purifying surface to the paper written by your Secretary, Mr. A. E. Forstall (7), for the last meeting of the Association. Until this paper was read, scarcely anyone had thought there was any field for investigation in the application of dry heat to purification. Many had attempted to admit steam with the gas, nearly always with poor success, and many have found it advisable and necessary to keep the purifying house warm in winter, but Mr. Forstall's plan of heating the gas only at the point of contact is, I think, the first effort of its kind. I understand that one of the New England works has been passing the gas at a higher temperature than usual from the condenser for some little time, but unfortunately I am unable to give any figures on the result of this method. The average temperature of the gas at the point of contact to-day

(6) Proceedings of the American Gas Light Association, 1893, Vol. 20, § 2, p. 217.

(7) Proceedings of the American Gas Light Association, 1896, Vol. 23, p. 201.

is 70°F. Mr. Forstall kept the temperature at 95°–100°F. at the outlet of the box. That it is expedient to supply heat to this reaction may easily be ascertained in the laboratory. Within certain limits the temperature, from a strictly chemical standpoint, may be increased to advantage, beyond the usual practice of to-day. I doubt if it would ever be advisable to carry the temperature above 150°F. even if this increase would be practicable. It should be possible to figure as accurately and as quickly on the temperature necessary to insure purification at any rate per hour with a given surface, as Mr. Crisfield has figured on necessary surface. Naturally any change in the temperature at the purifiers would in most cases entail a change in the method of reading the meter at the works unless condensation of some kind should follow the purifiers.

Unfortunately the conditions of most gas works are such that a catch layer of ashes, breeze, shavings or other porous material is necessary to protect the oxide from tar and like compounds. Tar will so quickly ruin a bed of oxide that it is cheaper to take it out than to use the oxide as a scrubber. The position of the catch layer beneath the oxide is hardly the best for good work because the separating water of hydration keeps it continually moist. Theoretically the condenser removes the last trace of tar or oil, but practically the catch layer is found thoroughly saturated after the third change. If the old boxes could be kept in position after new ones are built, or doubled into two instead of four, it would save money and time to use them as catch layers. 5 per cent. of tar will injure oxide, and in many cases 8 per cent. will ruin it irretrievably. The removal of the catch layers from the purifying box would effect a considerable saving in room which would be available for oxide. This would mean fewer changes and a saving in labor.

Regeneration in the purifying box is constantly becoming the more general practice. With but few exceptions it has not been very successful. The discussion of its value has developed two parties, one of which favors the exhaust process, either steam or power, drawing air down through the inlet and out, and the other side proposes to blow air, either with or without steam, up through the box. There are undoubted advantages to be gained from some method that will enable a bed of oxide to be kept in its position until all or nearly all of its capacity of absorption has been used. The continued molecular movement in the purifying box both in puri-

fication and revivification has undoubtedly been responsible for some of the successes and some of the failures. Anyone who wishes to ascertain for himself the effect of this motion on a body of oxide may find it instructive to place a measured tube in position as a purifier, pass foul gas through until the mass is saturated, and then revivify by both methods. As far as laboratory experiment is a criterion the blowing up process is the better.

Regeneration in the purifiers is admittedly but a labor-saving device, and even its warmest advocates admit that the bed must be changed after the third or fourth reviving. If there are to be twenty changes or more, then regeneration in the box even under stress of complete removal after the third change would be an economy. My argument in this case concerns itself with the necessity for so many changes of the box even under the worst conditions. The practice of admitting one to two per cent. of air with the gas has been proved economical in so many cases that ample data may be had from a number of sources. Mr. Forstall's method of heat at the point of contact certainly saved him a number of changes, for his average purification between changes for a year before the adoption of this method was 10,000 cu. ft. per bushel, using one and one-half per cent. of air, and his average with heat was 30,000 cu. ft. or more, thus saving him every third change at least. Using all the methods available for purifying more gas between changes it would seem that the necessity for regeneration in the box would almost disappear, except in a few cases where room is at a premium. In the samples of spent oxide from works using a regeneration *in situ* process, the particles are more agglomerated than usual, as if the heat had at some time quite or nearly reached the fusing-point of sulphur. This in itself is a cause of the exhaustion of some beds of oxide, the particles of fused sulphur forming coatings on the outside of particles of oxide and preventing further contact with the gas.

A few of the English gas works use a method of floor revivification, which is also in use here in this country to a limited extent. Old purifier trays, or new ones, of yellow pine, conveniently made at the works, are so supported from the floor or ground as to permit a circulation of air beneath the bed of oxide. This circulation stimulates regeneration in a manner similar to the action of a draught on fire. After exposing a 30-inch bed for a few days on this platform, it will be noted that the oxide has stratified into three

layers. Regeneration is nearly complete at 12 inches from the bottom and 6 inches from the top and a 12-inch layer in the middle is still foul, thus proving that regeneration from the bottom proceeds at double the speed of top regeneration. When the bed must be turned over, two-thirds of the foul oxide is thrown on the trays, then all the regenerated oxide, then the remaining third of foul oxide, or, all the foul oxide is thrown on the trays with the regenerated on top. This method should be in more general use, for it saves half the time and labor of the present practice, and costs very little to introduce.

RUST DEPOSITS IN HOUSE PIPES.

WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY FRED. B. WHEELER.

Every superintendent of a gas company has heard the complaint, "The pressure is poor at our house." Investigation of the trouble has frequently proved the cause to be due to accumulations of rust in the house pipes, the obstructive matter being variously distributed through the pipes, the riser ell, and the leader pipe from meter to riser.

The superintendent, in cleaning out the rusty matters from the house piping, has often been astonished at the great quantities of rust blown out, several cigar boxes full sometimes being brought in by the foreman as a proof of the thoroughness with which he has done the job. The superintendent has sometimes exclaimed: "Where did all this come from? Are any of the original pipes left? Have they all gone to rust?" Patrick has replied: "The pipes all seem *rale* good, sir."

It is now proposed to investigate,

First. What does this rust consist of?

Second. Where did it come from?

The interior of gas pipes may be corroded by rusting in four different ways:

1. In scattered patches.
2. In a pimply or "goose flesh" way.
3. In longitudinal grooves.
4. So uniformly all over that nothing unusual in the inside appearance of the pipes can be seen.

In order to rid the question at the start of several doubtful points, the fourth way has been chosen for a careful analysis.

A large hotel built in the sixties was thoroughly overhauled under my supervision this Spring. Deposits of rusty matter were found quite uniformly all through the pipes, but in the leaders from three meters, the deposits were enormous in amount. The pipes showed no internal corrosion to speak of, appeared smooth, and in

many cases, black inside. About 12 pounds of this rust was carefully collected. 8.68 pounds were devoted to the general series of experiments, the balance for special tests. The former were mixed together, and quartered down to a small amount, so that the mechanical result was a fair sample of the whole.

Inspection showed the presence of:

- a. Iron rust.
- b. Naphthaline scales.
- c. Oxidized white lead in scales.
- d. Spongy lumps.
- e. Grit, &c.
- f. Scales taking shape of pipe.

The "scales taking shape of pipe" were mostly dislodged by hammering, to free all the particles. These scales were black and resembled the oxide scales from new pipe, or freshly heated iron, cooled in air at the anvil, but were dead black as though acted on by moisture to some extent. The whole smelled very "gassy," was dry and dusty. Several crucibles were weighed, filled with the samples, weighed again, and heated in a Bunsen flame to a bright red heat for one hour each. The crucibles were then cooled and weighed again. The loss represents the weight of the contained hygroscopic moisture and the volatile matters of the hydrocarbons contained as naphthaline and dried, spongy, tarry, lumps, sulphur, &c. The average of ten crucibles showed an average loss of 29.8% volatile constituents. The smallest loss was 28.6%. The largest loss was 31.7%, showing not very wide deviation from the average. The residue obviously contained iron as sesquioxide, grit, oxide of lead, &c. Samples dried in an oven for several hours each showed an average loss of weight at a temperature of 180° F. of only 2.14%.

Digestion in cold absolute alcohol and careful filtration and weighing showed a loss of 2.17%, due to absorption of the naphthalines.

The determination of the amount of sesquioxide of iron present with the sulphur and hydrocarbon compounds was found to be rather a difficult task obviously. Most of the methods laid down in the text books for the determination of the amount of sesquioxide of iron contained in various ores are not properly applicable to this determination on account of the numerous sources of error that creep in, and especially to the difficulty in preventing some.

of the iron from oxydizing away in reducing the ferric solutions to ferrous ones for quantitative work.

The methods have to be performed under a current of CO gas, have to be cooled rapidly, air-free water must be used in all the operations, so that after numerous trials of different methods, the rule of Fresenius was adopted, the precipitation of the iron as a hydrated sesquioxide.

The weighed samples were digested in warm hydrochloric acid for a considerable time, the whole contents of the beakers were transferred to porcelain evaporating-dishes and mixed with an excess of strong ammonia. The solution was then raised to the boiling point, decanted repeatedly into a filter, washed profusely with hot water, and dried very thoroughly at 212° F. The filter with precipitate was then kept forty-eight hours in a desiccator until it showed a constant weight. The filter and precipitate were then carefully ignited at a bright red heat for an hour. The crucible, after cooling in the desiccator, was weighed, re-ignited, cooled again, and weighed for a constant weight. The average of three determinations in this way, after deducting the filter ash, was 69.7%. This residue consisted of anhydrous sesquioxide of iron with a small amount of siliceous matter that was found after resolution and filtration to be 0.4%, leaving as sesquioxide 69.3%.

To determine the sulphur trioxide, a solution of hydrochloric acid with the rust was boiled, filtered, bromine was added, the solution was boiled again, an excess of normal solution of barium chloride was added and the whole boiled again for ten minutes. After thorough stirring, the solution was filtered and the filter washed with hot water until alkaline. The precipitate was dried, weighed, ignited, and weighed again as barium sulphate. The amount of this sulphate multiplied by its combining number 0.343 gives the sulphur trioxide. The amount present was found to be 3.51%. The first precipitate from the hydrochloric acid solution was dried at 212° F. The temperature being raised to 220° F., sulphur fumes were given off, showing the presence of sulphur either as a residue of SO_3 , as CS_2 or possibly some free sulphur. These fumes crystallized on a cold watch glass in minute needles. This first precipitate was then digested with bisulphide of carbon in the same manner as in determining the sulphur in used sponge. As a result, an additional 1.23% of sulphur was extracted. The balance of the components of the samples amounting to 21.25% was of

course consumable carbonaceous matter with a trace of lead as an oxide. The average loss of combustible and volatile constituents from ten combustion experiments has already been shown to be equal to 29.8 per cent. of the whole. From the general analysis the same matters are shown to be equal to 30.3 per cent.

The difference between the two sets fairly represents the error of the experiments to be 0.50%; hence the composition of this particular batch of rust deposits is made up as follows :

Oxide lead	trace
Moisture	2.14
Siliceous matters	0.40
Sulphur trioxide	3.51
Sulphur compounds	1.23
Naphthaline	2.17
Sesquioxide iron	69.30
Carbon	20.75
Errors of experiment	.50
	100.00

Three things in this analytical scheme will at once catch the attention.

- a. The small amount of naphthaline.
- b. The presence of sulphur compounds in quantity.
- c. The large amount of carbonaceous matters.

As to the first, it is all there was. The sulphur was undoubtedly due to twenty years' use of coal gas with lime purification. The carbon will receive attention later on.

It must not be assumed that all rust in all house pipes every where is composed like the above, for it is not; not even in the same building. The smallest amount of sesquioxide found in any one sample was 24 per cent.; the largest was 79 per cent. The quantity of iron contained in the rust of the leaders and risers is greater than that in the rest of the same building usually. The quantity of naphthaline varies enormously. In this particular building under test, the naphthaline in the small house pipes on top floors was at least five times that in the leaders, being in one case 11 per cent. of the sample. The moisture varies very markedly, also the carbon content, which last was greater in the leaders, keeping step apparently with the iron. Nevertheless, on account

of the large quantity of rust sampled, and the numerous experiments, and partial experiments made, it is believed that the analysis represents fairly well a large average of finds.

We have now investigated the question: What does this rust consist of? Let us now turn our attention to the second question, Where did it come from? This inquiry can be pursued in the same building as before.

A 1½-inch leader pipe from one meter in this hotel had certainly, from the way in which it had been built, never been disturbed or blown out since the erection of the building. This pipe was a single length, 18 feet long, with a slight trap in it, but no water. The contents were dry and dusty. The pipe was lifted down and the contents preserved. It contained 8.68 lbs. of rust. One foot of this pipe was carefully cut off and filled full of the rust. The contents of this foot weighed 13.23 oz. Since 18 feet contained 138.9 oz., the pipe as found was 58.3 per cent. of being actually full of rust, or a little more than half full. The empty length weighed 43.38 lbs. or 2.41 lbs. per foot. A standard new black iron pipe weighs by card 2.68 lbs. per foot. The present pipe standard was adopted in 1872 at the instance of Morris, Tasker & Co., who were then the only mill of any size making pipe here. This firm was the only manufacturer of pipe in this country previous to 1870. They always had this weight as their standard. This hotel was erected by Philadelphia parties, so that it is almost certain that Morris & Tasker made this pipe. A comparison of internal and external measurements of this length, with full-weight new pipe, show a very close agreement. It can be assumed closely then, that the length of pipe in question weighed when new 2.68 lbs. per foot. Consequently the loss of weight was 0.27 lbs. per foot. This loss was, from careful examination, judged to be equally divided between the external and the internal loss by corrosion. Then 0.135 lbs. per foot was the amount of pure metal lost by internal corrosion, or a total of 2.43 lbs. This corrosive loss occurred in the usual way. The oxygen of the air and moisture, when no meter was set, also the CO₂ present in the gas with the moisture of condensation uniting to bring this about.

As 69.3 per cent. of the rust deposits were found in analysis to be iron rust, $8.68 \times 69.3 = 6.015$ lbs. of iron rust were in the contents of the pipe, or 4.21 lbs. pure metallic iron, since the combining equivalent is 0.70. The difference between the assumed loss

of weight and this quantity leaves 1.78 lbs. pure metallic iron, which was carried into that pipe and deposited there as rust from some point on the works side of the meter. Where did all this iron come from? How did it get there? Was it mechanically transported there in the gas as fine particles of iron sponge? I think not. The works had only used sponge two years, using lime before. Nor is there erosive force enough in the gas to take up mechanically particles of iron or rust from the inside of the mains to any such extent. It is my belief that it came from the presence of carbonyl of iron in the gas in minute quantities.

Berthelot states that carbonyl of iron—a volatile substance—is condensible to a liquid at 32° F., a common enough temperature. This fact determined me to attempt to synthesize the liquid carbonyl by passing a quantity of illuminating gas—carburetted water gas—through glass tubes enclosed in a freezing mixture in amount sufficient to form a weighable quantity.

A coil of $\frac{1}{2}$ -inch glass tubing of ten turns was embedded in a freezing mixture in such a way that the gas from the meter passed through the coil on its way to the burner, which consumed about 4 feet per hour. The temperature was kept at 0° F. During four days and nights, or ninety-six hours, gas was passed through this condenser until 400 feet were registered. Some little trouble was experienced the latter part of the time from condensation, so the burner was abandoned as unnecessary. This condensation in the coil was carefully saved. The tube was shaken full of hydrochloric acid, then washed out with the same and hydric nitrate, HNO_3 . The original condensation was put with these washings, neutralized with ammonia and tested for iron with a solution of potassium ferrocyanide. The test gave the Prussian blue of iron content at once. Upon reducing the solution and titrating with ammonium sulphide, 0.436 gram of iron were found for 1,000 cubic feet of gas. This gas was regular carburetted water gas with the analysis at time of experiment of—

Illuminants—	14.00
CH—	19.80
H—	32.00
CO—	27.40
N—	3.65
O—	.45
CO ₂ —	2.70
	100.00

The purification was by iron sponge, home made, in use some time.

Since making the above experiment it has been brought to my notice that Sir Henry Roscoe, in November, 1892, published an article in which he stated he had made this experiment, using ice around the condenser, temperature about 32° .

I have repeated his experiment with 200 feet of gas, and making the proper calculations, in titration, 0.417 gram was deposited per 1,000 cubic feet of gas of practically identical composition.

There may not have been as much iron in this gas, the reason of less iron may have been a manipulative one, or may have been due to the lesser degree of cold for condensation, about 30° above the other experiment. These experiments, together with Sir Henry Roscoe's, conclusively prove that metallic iron carried in illuminating gas as carbonyl may be deposited in the mains or house pipes, provided the latter are cold enough and all other conditions suitable.

In the experiment at 32° 0.417 gram was thrown down per 1,000 feet. As 1 gram = 0.0353 oz., it would require 1,087,000 feet to deposit 1 lb. of iron—the whole to pass through at a point about freezing.

In the 18-foot length under consideration 1.78 lbs. were carried in as a deposit, during about thirty years, requiring probably 1,934,800 feet of gas loaded with 0.417 gr. of iron. Many of the winters no gas was used, the balance of the period this pipe fed gas to a family. Certainly 3,000,000 feet of coal and water gas passed the meter within that time.

It can readily be assumed then, that in our ordinary temperatures met with here, from 20° below to 32° above 0° F., carbonyl of iron, if present in gas, will deposit more or less, and oxidize into rust in all house pipes. The coolest part of a house is the cellar usually; and it is in the cellar piping, the leader pipes from the meters, and at the bottom of riser ells, that we find the largest accumulations of rust. Our analyses have shown that more iron and carbon are found in the cellars than anywhere else, with less naphthaline. This is explainable probably in this way: The cold deposits there the carbonyl of iron more readily, also the naphthaline; but with warmer weather or hotter gas, the naphthaline is carried farther along to the burner and consumed, or again deposited in the upper stories, as, indeed, we have found it in the case at hand.

Can these deposits be prevented? If the gaseous carbonyl be kept down to the lowest point in the illuminating gas by the use of proper purifying material, there will evidently be less to be deposited. If the temperatures of buildings and cellars are kept above the critical point of deposition, there will undoubtedly be less trouble from this source, although I believe it possible for the carbonyl of iron to be thrown down at temperatures considerably above the point of liquefaction in the following manner, analogous to the action of nuclei in a freezing liquid. Some liquids may be kept so at temperatures several degrees below their critical freezing points, but if a small particle of solid matter be dropped in, freezing starts at once, with this particle as a nucleus, and rapidly permeates the whole. So with carbonyl of iron in a gaseous condition at temperatures above the critical point of its liquefaction, if particles of naphthaline or aqueous vapor be thrown down in the gas, they may act as nuclei to drag out particles of carbonyl of iron in unstable equilibrium, from the gaseous to the liquid state. These may be dropped in a finely divided mist with the naphthaline; that, later, under a change of temperature, is picked up again by passing gas and carried on farther, leaving the probably now oxidized carbonyl as the regular and familiar sesquioxide of iron, or red rust, some free carbon and moisture. It is my belief that naphthaline and condensed aqueous vapor deposits are the primary causes of much of these rust deposits from this hypothetical and mutual interaction.

If the literature upon the subject of carbonyl be examined, it will be found that carbonyl of iron is indeed a volatile substance. It is a crystallized solid a degree below 0° F., a liquid at 32° and a gas at temperatures above and readily distills over at 212° F. There is indeed a striking analogy between this substance and many other carbon compounds such as:

Benzol, solid at 32° F., boiling 177° .

Bisulphide of carbon, solid at 10° F., boiling 116° .

Several ether compounds, and singularly enough, water.

The well-known phenomenon of the condensation of water from the gas passing through our mains is now a point to which I wish especially to call attention, as bearing vitally upon this question. It has, of course, been known that this condensation depends upon a fall of temperature below that of the distributing holder, together with the tension of aqueous vapor carried. If the flowing gas, at

a certain temperature and aqueous vapor tension, drops in temperature before reaching its destination, there must inevitably be a deposit of moisture somewhere on the line. In this regard I wish especially to refer to the paper by Mr. W. E. McKay, of Boston, read at the Twenty-seventh Annual Meeting of the New England Association, February 17, 1897; subject, "Temperature." The average August, 1897, ground temperature of the gas issuing from the street main at inlet of station meter at one of our stations here, the gas having been pumped seven miles, was 74° F. The average temperature for the first ten days in August of the dark, cool cellar of the hotel whose pipes are the subject of this investigation was 63° . The gas probably fell then from 8 to 11 degrees upon entering this building. The average minimum temperature of the outside air in August was 65° . The average maximum temperature was 82° , both on our recording thermometer. This cellar temperature is then readily explained. From Mr. McKay's table for water gas, *saturated* with aqueous vapor, a drop from 74° to 63° would represent the deposition of 0.42 lb. of water per 1,000 cubic feet gas. The season of 1896, 101,200 feet of gas far from saturation passed this meter, leaving in the drip about 3 quarts of water. This water was not measured exactly, only estimated, but the facts are brought together here to illustrate the point I wish to make which is, that aside from the deposition of any naphthaline particles, there was a *continual* deposition of condensed aqueous vapor in the pipes, of course in the form of a fine mist. Now $\frac{4}{5}$ of all the gas passing through the meter on this leader pipe went through in the three summer months, hence to account for the total amount of extra metallic iron carried in during thirty years, there must have been during the summer season, also, a deposit of carbonyl of iron, which was carried down by the condensing aqueous vapor, as well as by any naphthaline. Naphthaline has always been a bugbear and an erratic thing. I believe that the extremely volatile carbonyl of iron also is a thing of vagaries—with its solid state at -1° F., liquid at 32° F., and gas the balance of the time, but decomposing at 356° F.*

*NOTE ON TEMPERATURE DIFFERENCES.—Mond & Quincke give the following Temperatures; they used pure CO gas and metallic iron:

Liquid at -20.0° C. = -4.0° F.	Distills over at 102.8° C. = 217° F.
Solid at -21.0° C. = -5.8° F.	Decomposes at 180.0° C. = 356° F.

I found, using carburetted water gas:

Liquid at 0.0° F.	Solid at -1.0° F.	Distills over at 212° F.
----------------------------	----------------------------	-----------------------------------

These differences, quite uniform, are 4° F., and show the advancement of the critical points by mixture.

We have found in this investigation that rust deposits in house pipes contain about 69.3 per cent. of rust, Fe_2O_3 , or 48.5 per cent. pure metallic iron, a considerable quantity of which is carried into the pipes by the gas itself, due to the presence therein in an unstable condition of carbonyl of iron. This action can be readily produced experimentally by use of freezing mixtures. The action takes place in cold weather, also upon drops of temperature, and is hypothetically helped by the presence of particles of naphthaline and *aqueous vapor*, also probably to some extent by friction in the small house pipes. The amount deposited can be decreased by the use of good purifying material, by keeping the inside of houses warm in winter, by preventing the formation of naphthaline, by sending out dry gas, and by keeping down the amount of the useful diluent CO. Average samples of coal gas contain about 14 per cent. of CO, and carburetted water gas has about 27 per cent.

In the sample case here discussed, water gas had been in use ten years, and iron sponge purification two years only. During the thirty years that this deposit was growing, the probable 14 per cent. CO in the coal gas, and, later, the 27 per cent. CO in the water gas, had been slowly doing the work of picking up the iron from mains and service and dropping some of it as carbonyl of iron, under the proper conditions of instability, in this leader pipe, taking up no iron from the purifying material, which was lime only. How much of this rust was thrown down during the two years' use of iron sponge imperfectly oxidized, it is impossible to conjecture.

It can logically be asked: Why do not our street mains and service pipes clog up with these deposits, if formed as has been assumed? They do clog up in time, under the suitable conditions. I have taken up thousands of feet of service and hundreds of feet of 3-inch and 4-inch main in Schenectady, for instance, which were more or less filled with these deposits. In that latitude, the temperature runs down to 20 odd degrees below zero for a few days every winter, often freezing all around the main, so that the ground temperature is lowered to a point low enough for precipitation. Schenectady is a coal gas town with lime purification of thirty years' standing. Coal gas, lime purified, with only about 14 per cent. CO does not have as great carrying power, of course, for carbonyl of iron as water gas, but that it gets in its final work in time there can be no doubt. The long familiar "dead end main" troubles with burner stoppages, so well known to every old coal

gas man, need only be cited in this regard to distinctly prove the presence there of the iron.

Let us now attempt to explain the amount of carbonaceous matter found in the analysis. This amount was 20.75 per cent., or $8.68 \times 20.75 = 1.866$ pounds carbon. A small part was undoubtedly due to the presence of a small quantity of drip oil from condensation dried away, and insoluble in absolute alcohol, but the major part was undoubtedly due to the decomposition of the carbonyl.

The molecule of carbonyl of iron is $\text{Fe}(\text{CO})_5$. Its weight is then 196 made up of $\text{Fe} = 56$, $(\text{CO})_5 = 140$. Consequently the amount of iron contained is 28.5 per cent. and CO 71.5 per cent. Then for every pound of metallic iron deposited, 2.5 pounds of CO are set free. We found a surplus of iron amounting to 1.78 pounds in the pipe; then $1.78 \times 2.5 = 4.45$ represents closely the amount of CO set free. The greater portion then undoubtedly passed over into the gas as CO, the balance was left as a deposit of carbon in the pipe.

It is always a most interesting thing to meet with the varied experiences of other members of our fraternity, so it is with great interest that I turn to the proceedings of the Fifth Annual Meeting of the Pacific Coast Gas Association, published in the September 13th number of *American Gas Light Journal*. The matter referred to is the Question Box and the discussion. From this it will be seen that the familiar phenomena of rust deposits are well known in all their varied forms on the Pacific slope; that their 3-inch mains choke up there too; that service pipes are not stopped as often as house pipes, which last are very often found full of granulated rust, and that in New York city, long before oxide purification was known, "*granulated rust the size of gunpowder in many cases had partially filled the pipes where they were in active service right along, but very seldom where the pipes were out of use.*"

The consensus of opinion of the speakers seemed to be that these granulated rust deposits were more often found when the gas was on and in use right along; that this granulated rust is not found in service pipes as often as in house pipes, and that the inside of the house pipes did not seem to be affected at all when the gas was on all the time, although the pipes were partially filled with these deposits. The gas manufactured by the speakers was mainly coal gas. All of these opinions bear out the conclusions of this paper.

GAS ADVERTISING.

WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY R. M. SEARLE.

"We are advertised by our Loving Friends!" Has the Gas Company any Loving Friends? If not, why not? And if so, do they advertise you?

I am perfectly satisfied that a community, by careful and considerate treatment of their every want, can be classed as the Company's Loving Friends.

We are in the business to make money. Advertising conscientiously and scientifically done, does and will pay as well as any investment a Gas Company can make.

The most valuable and important advertisement a Gas Company can have is a neat, commodious office, with a clean, attractive front, brightly illuminated at night, wherein stoves, appliances and devices of every known kind for the use of gas are exhibited. I do not mean by attractive front a gem of plate glass plastered with theatrical or circus posters, nor a showroom in which there are several back number stoves connected with small pieces of white rubber tubing so kinked that the stove will flash back a half a dozen times when an attempt is made to light it, nearly frightening the customer to death, and creating an advertisement which in all probability causes a loss of many a dollar, nor in which the only illumination at night is a Jet Photometer back of the safe, while the office is a dungeon. We encourage a consumer to illuminate his store all night for the purpose of advertising, and if it holds good in his case it behooves us to have the brightest and best illuminated place in the city.

The word "Advertising" is a broad one. Soliciting business, twisting a criticism, or by paint and tinsel, one can make a paying advertisement. One should be forever on the alert to convert every criticism into an advertisement; if against the company by correcting it promptly, effacing its cause, and in all probability you will then have a Loving Friend, who will advertise you.

Have you ever noticed while spending the evening out a group of ladies scoring or praising the Gas Company, either because of some slight affront they were dissatisfied and were giving you an unprofitable Ad. gratuitously, or praising you because of some plain business courtesy they had received at the hands of one of the employés? When hearing such remarks has it ever occurred to you that you received a very valuable Ad. right then and there; did it carry a lesson? If against you, did you go home with the determination to do better and follow up the criticism by proving to your critic that the Company was not at all bad, and ready and willing to meet them on more than even terms; and if the criticism was favorable did it spoil a good thing and cause you to cease trying to still further increase your advertisers?

The writer had the good fortune to have a crew of subordinates, each and every one a standing advertisement, each man treated as though he was a human being, educated to answer questions with intelligence, or refer them to some one of the Company who could, and I found that each was doing his level best at every opportunity to advertise the Gas Company and increase its business. From the trencher to the highest man in the Company's employ, each in his class was continually striving if not to make a direct sale of an appliance, to at least advertise the merits of our product. Many hundreds of little ways would suggest themselves to each in his class and if encouraged, one would be very much surprised to see the novelty of the different advertisers among the employés.

Each consumer if properly handled will be an advertiser for you. Study your consumers and avail yourself of their good will. Do not kill the goose that laid the golden egg; treat them just as you would like to be treated and you will find that each consumer in turn will secure you another. I only wish that I could find words to express how really important this one little point is; there are others, but——

Mr. A, Editor of the Laborers' Friend, comes into your office; he is in good faith, probably has an excellent advertising medium for reaching the people with whom you could do the most business if your Ads. read properly. You have an idea up your sleeve that newspaper Ads. are worse than useless; you give him one that reads like this: "A gas stove will toast ice cream better than by any other method. Eureka Gas Co." The next morning 5000 of Mr. A's subscribers read this Ad., or don't read it. I can just imagine

the conversation of the average laborer's family as he runs across this Ad. What do I want with a gas stove that toasts ice cream? and the paper is laid aside. A little later Mr. A comes in for another Ad., you tell him you guess not, newspaper advertising don't pay, you know it don't, you have tried it and you cannot trace a sale to the Ad. that you gave him.

I think advertising could be safely classed amongst the sciences, and like all sciences with study one can soon master it. I am not referring to newspaper Ads. entirely, but to every scheme, device, deal, courtesy or action that can be twisted into an Ad., or almost anything that can be made to do your Company good.

Another example: Mrs. A has just blown up her gas stove and inside of an hour the entire town has heard of it; then, of course, it reaches you in your den behind the holder; you say "the game is up, no more stoves sold this month." This is an advertisement that perhaps has travelled throughout your entire territory within a half an hour. Now for the reaction or boomerang; I suggest a double Ad. that will help you out wonderfully.

First, don't have a den behind the holder, be up on the main street, where you can catch onto things as soon as your neighbor does.

Second, if politic, at once proceed to the printer's and order 5,000 dodgers that read something like this (first, of course obtaining Mrs. A's consent, which you can probably do by making her a present of another gas stove): "Mrs. A, 210 B street. blew up her gas stove this morning and she is now arranging dinner on another. If this had been an oil stove what then? You all know the rest, her husband would go without his dinner to-day." Now, Mrs. A started the agitation of the gas stove question that day, and some such method of availing yourself of her accident would prove that advertising did pay and your sales would go up instead of decreasing.

If an advertisement can injure from a dollar and cents standpoint, why cannot other advertisements if properly worded and carried out earn you money from the dollar and cents standpoint? It is a rule that works both ways.

The Gas Company can well afford to lay aside a fixed amount per thousand cubic feet if no other unit is available for advertising purposes, and if a careful record is kept and a study carefully made the earnings can be arrived at.

We will assume a town of 25,000 inhabitants, with about 3,000 consumers on the line of mains. Make a canvass of each house in this town for the number of the $\frac{3}{8}$ capped nipples that are sticking through the walls of the respective houses and you will probably be astonished at the large number your canvass will show up. Now here is a word for one of the best-paying investments; for instance, put an Ad. in the paper that would read about like this; "The Gas Company will give away free of charge and place in position 1,000 one-swing gilt brackets, burners, etc., complete, not more than five to any one house or factory." Now assume that only one-half or 500 of these brackets are used each night and that each one in use is consuming three feet of gas per hour and is used but one hour per night, this equals 1,500 feet or 547,500 feet per annum. Now take your profit figure and see what this would earn you. The cost will be about as follows: 1,000 brackets, if purchased in 1,000 lots, \$200; freight, \$500; labor, tools, etc., \$120. The estimates I have given of consumption I consider very modest. If larger consumption exists why then the advertisement pays so much better. This costs as an advertisement about thirty-two cents per bracket, will last for years and might be termed a compound advertisement, as for every additional gas jet placed in a community just so in proportion will you be advertised. Of course if your Company is wealthy you can go into such schemes as this on a larger scale, but I simply cite this example to prove that advertising must pay.

The writer was once stopped by a consumer who told him that he had just heard that the Gas Company had a splendid advertisement on a main street in a certain store. The writer went immediately around that way to see what advertisement existed that so impressed one of his customers and found two broken mantels and four badly seared mica chimneys on Welsbach lamps. If the consumer considered this an advertisement, and which it surely was, what could I think? The first thing was to talk it over with the storekeeper and see if it were possible to fix him up properly at the prevailing prices. He didn't feel that he could afford to do it, nor did I feel that the Gas Company could have a standing Ad. at such a serious cost to its welfare. We fixed him up free. To say that he was pleased does not half express it. By dropping a gentle suggestion to him he did not advertise the fact that we had done the work free, but pointed out his improved illumination to his neigh-

bors with great pride and created, as I think, one of the Loving Friends I spoke of in the opening of the paper.

Have you ever concentrated three or four women together in a back yard or at a kitchen stoop to criticise or praise the handsome loaf of bread just turned out of a gas oven in which you had baked it yourself because the woman was skeptical as to the work a gas stove would do? Say there are four in the crowd, one has a stove the other three make up their minds then and there that they must have gas stoves too. Inside of six months the four have stoves. Have you appreciated that this one loaf of bread, baked on the edge of a ditch perhaps, the dough being taken from the same batch from which the critical woman was about to bake another loaf in a coal stove, which loaf when finished did not compare at all favorably with the gas-baked bread, would so advertise you when the four had stoves that if time were taken you would find that there was a geometrical progression in the increase of stoves due to this one advertisement. The connecting of a stove on the edge of a ditch, operating it and baking the aforesaid loaf may have cost \$2 or \$3 but I am satisfied that it pays.

Another great advertisement for gas is a Gas Engine, kept in nice order and in perfect running condition by the Gas Company. If the consumer neglects to do it you can, in consideration of which caring for the engine you can bring a consumer at any time and exhibit its work. The fact is, all Gas Engines should be kept in perfect order by the Gas Company aside from repairs which can be done at a trivial cost. Say your community is a manufacturing one and you are visiting a Club some night, half a dozen manufacturers are around discussing economies and management. Mr. A says: "I am going to put in a Gas Engine. I saw one over at Mr. B's, and I am so thoroughly satisfied with it that I have decided to put one in." Now if Mr. B's Gas Engine had been in bad shape Mr. A never would have considered the subject. Here is an advertisement that starts you on the road to place three or four more engines or lose the sale of three or four. The writer considers this a serious matter because my competitor, the Superintendent of the Electric Company, made a very profitable Ad. out of a Gas Engine that had no care taken of it whatever and had lost the sale to me of some two or three before I got onto the base of his argument. One should not merely place an Ad. or assume that one Ad. was sufficient for all time, but should keep pounding away,

small drives at a time, and, in fact, I can never see an end to the advertising part of the business.

A few years ago, on every stone fence, barn and newspaper, we saw the sign of a famous healing oil; to-day you scarcely find an advertisement of it; the druggists tell me it is rarely if ever called for, while they know that other oils that are equally advertised to-day, are selling in equal quantity as compared with the sale of the original advertised article.

When installing appliances put in only the best if you wish your product advertised. Only the best appliances should be considered. If you are going to try an appliance and are doubtful as to its success, try it in your own house or works, as nothing attracts so much attention as something new, and you may be mortified to find how your failure or its failure has been advertised.

Those of you who have not tried the cooking school and its lectures, I recommend to do so; it is a very valuable aid towards the increase in sales of gas. Taken as a whole it is the one educator for the future success of the gas business.

A manager is apt to think that with a couple of thousand stoves or so, Welsbachs, etc., that he has advertised in various ways awhile, that it is useless to go on. Let me dispel that idea. because you might advertise forever, and if you will take the trouble to go out and associate yourself with the public, you will find that there are people still who have never heard of a Welsbach or a gas stove. Here, of course, is an opportunity to use your wits, devising some way to secure business. Whatever you do, do well. Bear in mind that it seems to be human nature to kick at a defect in a job; be it in service trench or appliance or treatment of your consumer, it will be advertised to your cost.

I once overheard a man scoring the gas company for referring him to a plumber when he wanted another jet put in at his shop. It occurred to me that that sort of advertisement we did not want, so when I returned to the office I started a record of just such applications, and when I looked over the records some months later was astonished to find that we had referred to plumbers a total of 158 small jobs, each requiring an additional burner, and upon investigation only three of the parties so referred had the work done. It then dawned on me that we had lost the gas consumption of 155 burners, whatever it may have amounted to, and it must have been considerable, because these people were looking for it rather

than having it forced upon them. We then started to handle just such work as this. During 1896 we handled 1,167 house piping jobs of this description and installed 3,903 fixtures equalling 4,850 burners, the result of following up criticism made by a dissatisfied consumer, for I feel that that was the origin of my intention to go into this sort of work. Now, assume that one-half of the 4,850 burners were used but one hour per day throughout the year they would consume at 3 feet per hour each 2,655,400 cubic feet. Now take your profit figure and see what this advertiser earned for us. I want to further add that from all the data I can get, we installed more fixtures during 1896 than all the plumbers previously installed in our territory during the preceding ten years, and I will further say that we so advertised gas that the increased demand for it in turn gave the plumbers more to do than ever before. Let me also suggest that you work in the word "gas" everywhere and upon every occasion possible. A good plan is to arrange with the newspapers to ask all advertisers of rooms, houses, real estate, etc., to let, if they arranged for gas; here is a "tip" to the landlord and most people tumble, and you can easily arrange it with the editor to insert and offer him, say five cents for each real estate Ad. where gas is specified as one of the inducements for renting.

When a large department store sells good goods at moderate prices and fair terms to the purchasers, then they are continuously advertised by their customers. Realizing this and working along these lines, I have had the satisfaction of seeing for the past five years its great value, and during that period our installation of appliances of all kinds for the number of consumers in our territory was phenomenal. The five years referred to show an increase of 114 per cent. in meters and 217 per cent. in stoves, and the output of gas trebled.

I wish to make a contrast of two advertisements: "First, a gas office where a lady is about to pay her bill through a "Hole in the wall," and the cashier grasps the money like a drowning man does a straw; without a word he receipts her bill and scales it back along with five silver dollars in change and with a contemptuous air, says "Next!" The lady says, "I would like to have my burners repaired so that I can turn them on." Cashier says, "Complaint clerk two windows down." It happens that the complaint clerk is at dinner, but the cashier doesn't care, and the lady walks out, while the gas company is out \$4 or \$5 per year and how much

more is hard to tell, lost by non-consumption from burners she is unable to use, probably corroded fast by still further mismanagement of the purifiers. This sort of Ad. is the most unfavorable kind the gas company can get. A "Don't-care-clerk" can make or break a gas company, and if a gas company has one and is broken it is solely the management's fault.

Second Ad.: A lady steps up to a clear counter, behind which stands a pleasant clerk, who politely passes the courtesies of the day, and as lady lays her bill on the counter, takes it in, unfolds and receipts it or clips the coupon while she is getting her money from her pocketbook, again folds it and places it in a neat white envelope with a clever advertising notice on its corner, gives her \$5 change in clean, brand new bills (a supply of same being arranged for with the bank and kept for just such customers whom you know to be fastidious, and encouraging those who are not to speak of the pleasure it is to do business with the gas company), and as the lady passes end of counter a clever clerk asks if it is in the company's power to improve the service at her residence. This is an easy method of avoiding and killing competition, and to those who have not availed themselves of it, let *mê* commend it as a sure cure. This same treatment is equally applicable to mankind; although it may savor of loss of valuable time and can be quickly handled and the time taken will be really made valuable and profitable. Each public-spirited act will increase your earnings and that is what we are in the business for. A man that cannot feel that way ought to quit his job.

I have not written this paper to say how we should advertise, but to encourage the already enthusiastic gas man and prod the laggard to more profitable work.

In closing I will quote a little paragraph from "Life": "There is a growing recognition of the fact that public spirit in a proprietor is a mighty good advertisement for a business."

A METHOD SUCCESSFULLY EMPLOYED TO OBVIATE TROUBLE FROM NAPHTHALINE.

WRITTEN FOR THE TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN
GAS LIGHT ASSOCIATION BY K. M. MITCHELL.

For ten long years we have battled with naphthaline. That it is a serious problem, which has no satisfactory solution as yet, every gas engineer will concede. In searching for a remedy, every suggestion has been followed up in the hope that some way might be opened up to meet the difficulty. We do not claim perfection for the remedy which is outlined in this paper, but we do think that much of the difficulty can be overcome by an intelligent application of the plan in use here in St. Joseph. We need not say that the contrivance is original with us, for it is not.

The real trouble began here with the erection of our new retort house, condenser, purifier and gas holder. It soon became a serious matter, so much so, as to threaten the business of the company. The fact that an opposition company, with unlimited resources and an active management, was on the ground seeking recognition and demanding their share of patronage, made the situation one of the gravest importance. As is always the case where there is active opposition, the public was not at all backward in its demands. It was no uncommon occurrence to be told that our gas was uncertain, and unless we could furnish a uniform light they would be compelled to give the other company a trial. Not being willing nor prepared to surrender the business of the old company to the opposition, a series of experiments was begun to meet the difficulty. With what success you must judge when you have made a practical test of the plan.

Naphthaline made itself felt in the inlet to the gas holder and in the consumers' service. As you all know, there are no more vulnerable points of attack than these places, except it be the outlet to the gas holder.

At the gas works, the inlet pipe to the gasholder is twenty inches. A hole was drilled in the crown of the gas holder directly over each of the inlet and outlet pipes. We have many a time attached a string to a plumb bob and dropped it into the inlet pipe and it would bed itself in the white mass as in a snow bank. Our first plan for clearing was to introduce gasoline into the inlet pipe by means of a small jet injector.

This remedy only transferred the naphthaline from this to another cool spot further along. It also caused the inlet pipe to leak because of the heating and the cooling, and the consequent contracting and expanding of the metal of the pipe. Another remedy suggested itself. We emptied of its water the last section of our Standard scrubber and moved the fresh water inlet to scrubber on section forward. The section which was emptied of its water was supplied with 74° gasoline. This remedied the trouble with the inlet pipe to holder, but the trouble continued with the service pipes of the consumer.

While searching for information in my Gas Journals, I came across the description in the London Journal of Gas Lighting, etc., of a patent taken out by L. Bremond in 1878 of improvements in means to be employed in preventing the deposit of naphthaline in gas apparatus, mains and fittings. The patent was dated March 13, 1877. The invention is based upon the assumption that dry gas or gas from which the vapor of water has been wholly or in a great part removed will not deposit its naphthaline while in a dry or nearly dry state. The invention consists, therefore, in drying the gas after it has left the washers or scrubbers, by passing it through a vessel or vessels of any convenient form containing a substance or liquid which absorbs moisture with avidity, such as chloride of calcium, quicklime, baryta, caustic potash, caustic soda, sulphuric acid, phosphoric acid and other substances or liquids having an affinity for water. By this means the gas was dried, but as most of the vessels through which the gas has subsequently to pass are supplied with water, and as the gas would in passing through come in contact with and absorb water from these vessels it is proposed that to the water with which they are charged a convenient quantity of oil, of nearly but rather lighter density than water should be added, so that the gas in its passage through these vessels should be protected from coming into contact with water; in other words, the cup of purifiers, station meter tanks, gas holder

tanks, station governor tanks, and, in fact, any other vessel ordinarily containing water, and through which the gas has to pass should be supplied with oil as well as water, in order to prevent the water from vaporizing and becoming incorporated with the gas. It is also proposed that after the gas has passed through the station governor and before it enters the mains, it (the gas) should again be passed through a vessel or vessels containing one of the desiccating materials before alluded to, in order to dry or deprive the gas of the vapor of water to the utmost.

Further, it is desirable that all syphons attached to the mains should be supplied with oil to prevent the gas from absorbing moisture from the liquid frequently contained therein.

As an additional safeguard to prevent the deposition of Naphthaline in the fittings of consumers, a box charged with quicklime or other before-named materials, may be connected to the outlet of the meter and between it and the pipe leading to the fittings and burners. The material may be renewed from time to time, or whenever necessity dictates.

We tried the above plan as far as we could with our existing apparatus and without entailing too great expense. The top layer of each purifier, we charged with quicklime. We covered the water in center seal, station meter and drips with a light oil, so as to keep the gas as free from moisture as we could. The result was a partial cessation of the evil in the inlet to the gas holder, and a slightly better result with the consumers' service. We continued this plan for five years. The trouble seemed to get worse and worse, and we were at a loss to know what to do for a permanent remedy. We were obliged to use 74 degrees gasoline in the inlet to holder, sometimes using a barrel a day to keep the pipes free. It was almost a daily business during the fall and winter months to have a team and wagon loaded with a barrel of gasoline and a pump with hose attached, to connect with lamp post, so as to pump from the barrel to the mains through the lamp post. We would select an elevated district so the gasoline would flow back through as great a length of mains as possible. In this way, we worked until in searching the files of the London Journal of Gas Lighting, etc., we came across the paper read at the meeting of the Eastern Counties' Gas Managers' Association, September 16th, 1896, by Mr. R. G. Shadbolt, of Grantham, England, entitled "The Self-Enrichment of Coal Gas."

The system is patented in England, and a description of the process as patented will best show the idea the inventor had in mind.

This invention relates to a method of enriching coal gas during its manufacture by the aid of its own productions.

The patentees, in their specification (which is not illustrated) say : “ It is well known that coal gas in the earlier stage of manufacture deposits in the form of tar, oil, etc., the greater part of its heavy vapors, a small portion of which, if retained, would have material effect upon the resultant illuminating power of the gas ; and we claim by our method to retain a portion of these vapors, which would under ordinary treatment be precipitated and absorbed in the tar.”

They propose to convey a portion of the partly purified gas—10% more or less, according to requirements—from a point generally found between the exhauster and purifiers (as usually placed), but varying with local conditions. The place required is “ where the gas contains the lighter hydrocarbon or oil vapors after the extraction of the tar or, in other words, where the gas contains the minimum of tar vapors with the maximum of oil vapors.” From this point, taking advantage of the difference in pressures here and at the foul main, if the point be after the exhauster a portion of the gas is returned to another point generally found between the hydraulic main and the condensers, the position of this point varying according to the quantity of gas being made. Under normal conditions and with the maximum make of gas the returning gas would be introduced somewhere about the condenser inlet ; with a small make of gas at a point nearer the retorts, and with the minimum make of gas at a point possibly half way or more back toward the retorts, taking care always that all the tar extracted from the newly made gas is drained off previous to its reaching this point. Generally speaking, the temperature of the gas here will be between 100 degrees and 130 degrees F., although, under normal conditions, the best results are obtained when the temperature is from 120 degrees to 130 degrees, at the point where the return and newly made gases intermingle.

The inventors claim that the old vapors contained in the returned gas prevent the precipitation of a portion of the heavier vapors still retained in the newly made gas, which, if left to ordinary influence, would condense out and be deposited either as liquid or solid. These heavier vapors are saturated or blended

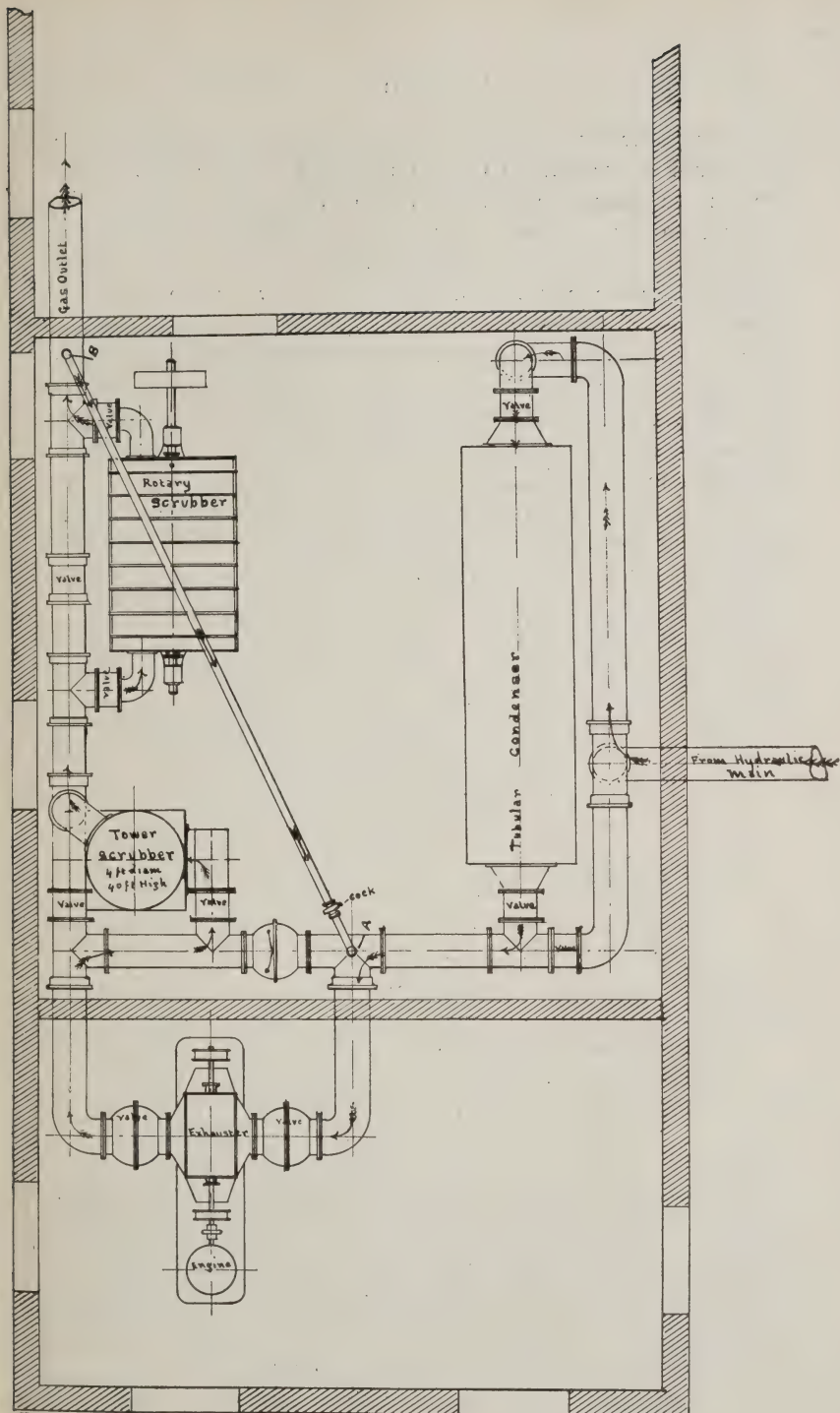
with oil vapors of the returned gas; and this being done in the presence of marsh gas, they are carried forward away from condensing influence of vapors already become liquid, and subsequently become fixed in the finished gas. Under certain conditions (extreme cold, etc.), it is sometimes advisable to slightly raise the temperature of returning gas, and when necessary this would be done by means of steam jackets, hot air jackets or other equivalent means.

The returning gas is conducted by ordinary pipes properly fixed, drained, etc., to a meter suitable in size and construction, where it is duly measured and conducted through one or more of the three or more branches to the point selected, as before mentioned.

We were skeptical of the arrangement at first, but resolved to try it, as it seemed to be inexpensive. We quickly connected the pipes together as shown on the sketch. We drilled holes marked A for two-inch pipe at the outlet of the condenser and before the exhauster. We also drilled a hole marked B in the pipe, after the standard or rotary scrubber. We connected these two openings together with a two-inch gas pipe, so that the gas, after passing through the exhauster and a tower scrubber four feet in diameter and fifty feet high filled from bottom to top with slats $1\frac{1}{2}$ inch square spaced $\frac{1}{4}$ inch apart and then into the rotary scrubber, was caused to return and pass over and through the exhauster, tower and rotary scrubbers. The pressure at the outlet of the scrubber was seven inches and the pressure at the inlet to the exhauster was nil. We calculated that about 8% of the gas was returned to the exhauster to be pushed through the two scrubbers again. The result was magical. The candle power of the gas showed a decided increase. The pressure gauge which indicated at the inlet of gas holder 60/10 pressure dropped to its normal height of 40/10 before the next morning.

We have been entirely free from naphthaline for ten months. We have been obliged to discontinue the use of the pipe on account of the small size of the exhauster we have in use.

The system requires that 8 to 10% of the partially purified gas be returned to the inlet of the exhauster. Our experience with the process has been in this practical way. The candle power of the gas was increased from 16 to $17\frac{1}{2}$ candle power and the deposit of naphthaline entirely prevented. We have not experimented as to a better location for the return pipe as Mr. Shadbolt seems to have



had some difficulty in locating in one of his experiments where the gas should be brought from, or from what point in the system after the gas had passed the exhauster it should be taken. Neither did we experiment as to the quality of the tar after the pipe had been connected. What we do know is that where we were once greatly troubled with stoppages from naphthaline, now by the small expense of a return pipe from one point of the apparatus to another the trouble is entirely removed. We have no other desire in presenting this paper to the Association than to help our brother Gas Managers, if perchance they are in the same trouble we were, to put themselves in a way to cheaply and surely get relief from Naphthaline.

We have copied from Mr. Shadbolt's paper the analysis and report of two samples of tar, marked A and B, received from Mr. Shadbolt, Gas Works, Grantham.

Both samples of tar were thin and light specific gravity, being drawn from gas condensers.

Sample "A"—Being the tar produced in the condensers in the process of ordinary working.

Sample "B"—Being the tar produced in the condensers during the process of enrichment to the extent of $1\frac{1}{4}$ candles.

(The specific gravity of ordinary tar, 1180/1200.)

	Sample "A."	Sample "B."
Specific gravity, water, 1...	1.135.....	1.134
Produced by weight.....per cent.....per cent.		
Water.....	1.90	1.74
Crude Naphtha.....	8.10	7.57
Light oil.....	9.26	7.26
Creosote	25.57	22.00
Anthracene and heavy oils.	21.48	19.35
Pitch.....	33.00	41.30
Loss.....	0.69	0.78
	100.00	100.00

The distillation was carried to the same point in each sample. Commercially there is little difference in the value of the two tars. There is a small but distinct difference in the percentage of the lighter oils; sample "A" being slightly richer in Benzols than "B," while the "B" sample contains a much higher production of pitch.

The samples dealt with were too small to permit of the determination of the quantities of pure anthracene and carbolic acid, which, however, would not materially affect the relative commercial value of these tars.

(Signed)

W. R. CHESTER.

From the foregoing report, remembering that the tar analyzed represented only 15 per cent. of the total quantity made, and that consequently the differences must be divided by $6\frac{2}{3}$ to arrive at their total effect, we may safely conclude that the loss in value is infinitesimal, and may be dismissed as a negligible quantity. In fact, greater differences than these exist between the tar produced from two different coals in the ordinary way. The only real loss may be said to be in quality, and may perhaps be the most easily arrived at from the pitch basis.

In comparing the two analyses, we notice that the proportion of pitch contained in sample "B" is 41.30 cent., by weight, against 33 per cent. in sample "A"; being an increase of 8.30 per cent., on the bulk, which practically represent the loss of oils, due to the enrichment process, and made up as follows:

LOSS DUE TO ENRICHMENT.	
	Per cent.
Crude naphtha.....	0.53
Light oil.....	2.00
Creosote.....	3.57
Heavy oils, etc.....	2.13
Total.....	8.23

For all practical purposes, therefore, we may take it that the loss in quantity is equal to 8.3 per cent of the condenser tars as variously expressed below:

8.3 per cent. of condenser tars absorbed per $1\frac{1}{4}$ candle per 10,000 cubic feet enrichment.

1.245 per cent. of total tar made absorbed per candle per 10,000 cubic feet enrichment.

0.996 per cent. of total tar made absorbed per candle per 10,000 cubic feet enrichment.

0.0996 gallons of tar used absorbed per candle per 10,000 cubic feet enrichment.

Cost per candle per 10,000 cubic feet, tar at \$6, per Ton, 0.3c.

We are aware that it has been the practice to take from the gas the troublesome Naphthaline, and expensive experiments have been made to accomplish this end. Our judgment is the Naphthaline should be kept in the gas, as it is a powerful illuminant.

Mr. George Livesay, in the year 1896, said, in the course of a discussion on the enrichment of coal gas, "They had in this substance the most splendid illuminant; and they had been hitherto anxious to get rid of it. If means could be found whereby the gas would be able to carry it, it would be one of the most valuable contributions they had had to the improvement of gas lighting."

We have seen how this experiment has helped us and we heartily recommend the arrangement as a long step in the right direction.

In Memoriam.



The strife is o'er, the battle done.



JOSEPH R. THOMAS,

New York, N. Y.

Died November 28th, 1896.

JOSEPH D. WEEKS,

Pittsburg, Pa.

Died December 26th, 1896.

JOHN W. NEWELL,

New Brunswick, N. J.

Died January 5th, 1897.

FREDERICK W. NORTON,

Nashua, N. H.

Died October 2nd, 1897.



Death is but the gate of life immortal.

JOSEPH R. THOMAS.

BORN, March 11th, 1820.

DIED, November 28th, 1896.

Joseph R. Thomas was born in Burlington, N. J., during a temporary sojourn there of the Thomas family, but was still an infant when his parents returned to Philadelphia, of which place they were residents. Having acquired his primary education in the public schools and under the tuition of his father, he was apprenticed to a carpenter and builder, and learned the trade of a carpenter. He next engaged in the grocery business, but soon became dissatisfied with mercantile pursuits.

Mr. John W. Starr, one of the members of the Camden Iron Works Company, then, as now, largely interested in the building of gas works apparatus, having taken a contract for work on some vessels that were being constructed in Hoboken, engaged Mr. Thomas at this time (1845) to assist in the work. Later, in 1848, Mr. Thomas entered the employ of the Camden Iron Works, and showed such aptitude for study and talent in putting into practice the knowledge derived from his studies, that he was soon selected to direct the actual construction of the gas contract work of the firm.

In this capacity he had charge of the construction of the new works of the New York Gas Light Company at 21st and 22nd Streets and the East River, the works of the "Gas Light Company of the City of New Brunswick," N. J., and the plant of the City Gas Light Company, of Norfolk, Va.

Then resigning from the service of the Iron Works, he engaged in construction on his own account, making necessary extensions to the works at Detroit, Mich. Returning to the East upon the completion of this contract, he was engaged for a year by a Philadelphian who intended to engage in the business of gas works construction, but finally abandoned the idea.

When the year expired, Mr. Thomas took a new departure, exchanging the field of construction, for that of direction, of gas works, by accepting (January 1854) the position of Engineer and Superintendent of the Williamsburgh Gas Light Company, formed in 1850 to supply gas to a district immediately adjoining the eastern boundary of Brooklyn. The works were in poor shape and the company practically bankrupt, but under the management of Mr. Thomas the affairs of the company prospered, until in 1861

it was the possessor of a works fully up to the times and equal to the demands upon it, which by reason of the amazingly rapid growth of its district had wonderfully increased. He retained his connection with the Company both as Engineer and member of the Board of Directors, until in 1883 differences of opinion as to the policy to be pursued in its future management caused him to voluntarily retire from all active participation in its affairs.

He then assumed editorial control of the American Gas Light Journal, which he retained until his death.

Mr. Thomas was elected an active member of the American Gas Light Association at the meeting held in New York, October 17th, 1883. He was also an original member of the Society of Gas Lighting, and its President from the date of its formation in 1875, and an Honorary Member of the New England Association of Gas Engineers, the Western Gas Association, the Ohio Association, and the Guild of Gas Managers. In all of these he was active, and his death, which came after a long illness, left a wide break in the ranks, and mourning among friends and associates, as well as his family.

JOSEPH D. WEEKS.

BORN, December 3d, 1840.

DIED, December 26th, 1896.

Mr. Weeks was born in Lowell, Mass., of Revolutionary ancestry. He was educated in the public schools of that city, and after some experience as a teacher entered Wesleyan University at Middletown, Conn., taking the scientific course. After graduating he was engaged in the ministry of the Methodist Episcopal Church, until threatening pulmonary troubles made his retirement necessary.

During the Civil War he was engaged in the work of the United States Christian Commission.

After the war he came westward, being employed in book work and as a newspaper writer. In 1872, coming to Pittsburg, he became connected with the American Manufacturer. In 1875 he was made associate editor of the Iron Age, and his comprehensive knowledge of the iron trade bringing him into notice, he became secretary of the Western Iron Association. In this capacity he took a prominent part in the first negotiations between the manufacturers and the Amalgamated Association of Iron and Steel Workers. In 1883 he was made secretary of the Western Pig Iron Association, and in 1886 took control of the American Manufacturer.

With his varied training and faculty of getting at facts, Mr. Weeks was well equipped for statistical work, and the Government called for his aid in the census of 1880 and that of 1890, while in 1885 he began work for the U. S. Geological Survey by reports on "The Manufacture of Coke," "Production of Crude Petroleum," "Natural Gas," and "The Production of Manganese," which subjects he has handled ever since. Quick to see the possibilities of natural gas as a fuel, Mr. Weeks began early the collection of the statistics that now form the principal record of its remarkable development.

Though brought before the public more prominently as a representative of capital, he always took a deep interest in labor and labor organizations, and in his "Report on the Practical Operation of Arbitration and Conciliation in Settlement of Differences between Employers and Employees," made after a study of the workings of arbitration in Europe, he presented facts which caused important subsequent legislation on this plan of settling labor disputes. And on this account, at the instance of the miners, he was made the head of a board of arbitrators appointed to settle an important mining trouble in the Pittsburg district.

Mr. Weeks' latest project was the manufacture of coke by the bye-product oven system, which he studied in Germany, making important experiments with American coal in bye-product ovens. The report on these experiments, prepared after his return, attracted great attention from American coke producers.

He was elected an associate member of the American Gas Light Association October 17th, 1894, was a member of the American Institute of Mining Engineers for many years, being its president during 1895, and an honorary member of a number of foreign technical societies.

Death came to him suddenly, and he passed in a few hours, as was his wish, from the rush of an active life to the quiet and repose of immortality.

JOHN W. NEWELL.

BORN, 1821.

DIED, January 5th, 1897.

Col. John W. Newell was born in Franklin, Ohio, and the first part of his life was passed in an earnest struggle with fortune, from which he came out equipped with the qualities that lead to success.

At the outbreak of the Civil War he enlisted in the Union Army, and his knowledge of finance and business led to his appointment as Paymaster of the main division of the Army of the Potomac. At the close of the war, he was assigned to settle the accounts of the United States with the New Jersey troops, making his headquarters at Trenton.

The settlement having been made, Col. Newell accepted the position of Superintendent to the "Gas Light Company of the City of New Brunswick," N. J., which position he held to the time of his death. The trust thus assumed was administered in a way that led to the prosperity of the Company.

He was elected an active member of the American Gas Light Association, Oct. 20th, 1875.

FREDERICK W. NORTON.

BORN, November 17th, 1868.

DIED, October 2nd, 1897.

Frederick W. Norton was born in East Boston, Mass., but when in his fifth year his father removed to Nashua, N. H., to take the position of Superintendent of the Nashua Gas Light Company. He was educated in the Nashua schools, graduating from the High School in the Class of 1886. Soon after his graduation he entered the service of the Company managed by his father, now known as the Nashua Light, Heat and Power Company, and at once began to master the details of the gas business, succeeding so well, that on the death of his father, in 1892, he was appointed to the position of Superintendent of the Gas Department of the Nashua Company. This position he filled with credit to himself and satisfaction to the Company until his death.

Elected an active member of the American Gas Light Association, October 19th, 1892, he was also a member of the New England Association of Gas Engineers and the Guild of Gas Managers.

The esteem in which he was held in his own town is shown by the following extract from a local paper:

"His business associates, the patrons of his corporation, his fraternal companions, his comrades in social life, his family—everyone acquainted with him, will find reconciliation to his early demise, to be no easy task."

UNITED STATES PATENTS RELATING TO GAS.

ISSUED OCTOBER 1st, 1896 TO OCTOBER 1st, 1897.

October 6, 1896.

- 568,814. GAS-ENGINE. Gustav A. Thode, Osmond, Neb. Filed Jan. 29, 1896. Serial No. 577,238.
- 568,842. PETROLEUM-VAPOR BURNER WITH OVERHEATER. Ludwig Dürr, Bremen, Germany. Filed July 8, 1893. Serial No. 479,931. Patented in Germany, March 28, 1893, No. 73,613, and June 17, 1893, No. 74,274; in Switzerland, June 28, 1893, No. 7,254; in England, June 29, 1893, No. 12,771; in France, July 5, 1893, No. 231,339; in Belgium, July 5, 1893, No. 105,415; in Austria Hungary, Oct. 10, 1893, No. 34,848 and 55,403; in Italy, Dec. 31, 1893, XXVIII, 35,188, LXIX, 89, and in Denmark June 20th, 1895, No. 83.
- 568,903. GAS-GENERATOR. Edward P. Harris, Chester, Pa., assignor to J. G. Gray, assignee of Queen & Company, Incorporated, Philadelphia, Pa. Filed Oct. 5th, 1895. Serial No. 564,706.
- 568,944. DEVICE FOR CHARGING HYDROCARBON-GAS GENERATORS. Arthur B. Griffen, Verona, N. J., assignor to the Gilbert & Barker Mfg. Co., Springfield, Mass. Filed Jan. 22, 1895. Serial No. 535,769.
- 568,956. HYDROCARBON-GENERATOR. Edwin G. Mummery, Detroit, Mich., assignor of three-twentieths, to W. G. Hastie and N. S. Wright, same place. Filed Feb. 8th, 1896. Serial No. 578,475.
- 569,056. GAS STOVE. Virgil W. Blanchard, New York, N. Y. Filed Mar. 18, 1896. Serial No. 583,719.
- 569,085. GAS STOVE. Virgil W. Blanchard, New York, N. Y. Filed Feb. 7, 1896. Serial No. 578,304.
- 569,139. BUNSEN BURNER. Eugene Moreau and Sidney Mason, Philadelphia, Pa., assignors to Geo. A. Myers & Co., Baltimore, Md. Filed June 18, 1896. Serial No. 596,000.
- 569,155. GAS BURNER. Peter Keller, Chicago, Ill. Filed Oct. 4, 1895. Serial No. 564,628.

October 13.

- 569,177. SCALE FOR WEIGHING GASEOUS SUBSTANCES. Alphons Custodis, Düsseldorf, Germany. Filed Apr. 24, 1895. Serial No. 546,967.
- 569,273. ACETYLENE-GAS GENERATOR. Alfred S. Bucher, Decatur, Ga. Filed July 15, 1896. Serial No. 599,310.

- 569,286. GAS-HEATER FOR CARRIAGES, ETC. Barend Janse and Jakob de Witte, Utrecht, Netherlands. Filed Sept. 20, 1895. Serial No. 563,059.
- 569,345. GAS, OIL AND WATER SEPARATOR. Albert P. McBride, Independence, Kans. Filed May 9, 1896. Serial No. 590,819.
- 569,365. GAS-ENGINE STARTER. Christian J. Weinman and Edward E. Euchenhofer, Dayton, Ohio, assignors to the Dayton Gas Engine and Mfg. Co., same place. Filed July 15th, 1896. Serial No. 599,212.
- 569,377. HEATER FOR ATTACHMENT TO OIL OR GAS BURNERS. Harvey J. Hallett, Rockland, Mass. Filed May 27, 1895. Serial No. 550,775.
- 569,386. GAS-ENGINE. Fred C. Olin, Buffalo, N. Y. Filed Feb. 11, 1893. Renewed March 13, 1896. Serial No. 583,134.
- 569,421. REGENERATIVE GAS-FURNACE. Louis J. Lemaire, Alexandria, Ind. Filed Sept. 26, 1895. Serial No. 563,698.
- 569,530. GAS-ENGINE. Harry A. Winter, Grand Rapids, Mich., assignor to the Sultz Gas Engine Company, same place. Filed June 24, 1895. Serial No. 553,897.
- 569,562. GAS-LAMP. James F. McElroy, Albany, N. Y., assignor to The Consolidated Car-Heating Company, same place. Filed Nov. 17, 1894. Serial No. 529,174.
- 569,564. GAS-ENGINE. Fred. C. Olin, Buffalo, N. Y. Filed Aug. 7, 1894. Serial No. 519,628.

October 20.

- 569,658. GAS-HEATING APPARATUS. Matts L. Nyberg, Erie, Pa. Filed April 11, 1895. Serial No. 545,370.
- 569,694. GAS-ENGINE. Max W. Weir, Newark, N. J. Filed Nov. 29, 1895. Serial No. 570,459.
- 569,708. APPARATUS FOR MANUFACTURING ACETYLENE GAS. John H. Exley, Bradford, England. Filed Aug. 31, 1895. Serial No. 561,066.
- 569,716. GAS APPARATUS. Thomas Hennessy, Excelsior Springs, Mo. Filed Sept. 24, 1895. Serial No. 563,523.
- 569,785. ELECTRIC GAS-LIGHTING BURNER. William E. Cram, Boston, Mass. Filed Jan. 29, 1896. Serial No. 577,225.
- 569,868. SAFETY GAS-BURNER. William Gates, Woodbridge, and Louis W. Gates, West Haven, Conn., assignors of one-third to Geo. H. Smith, New Haven, Conn. Filed Mar. 18, 1896. Serial No. 583,692.
- 569,918. GAS-ENGINE. Henry C. Hart, Detroit, Mich. Filed May 31, 1894. Serial No. 513,061.
- 569,942. APPLIANCE FOR STARTING GAS AND OIL MOTOR ENGINES. Hermann Schumm, Cologne, Germany, assignor to the Gas-Motoren-Fabrik-Deutz, Cologne-Deutz, Germany. Filed July 7, 1896. Serial No. 598,285.
- 569,984. AIR AND GAS MIXER AND HYDROCARBON FURNACE. Virgil W. Blanchard, New York, N. Y. Filed Sept. 22, 1896. Serial No. 606,641.

lxxix

October 27.

- 570,008. GAS-GENERATOR. August Dauber, Bochum, Germany. Filed July 17, 1896. Serial No. 599,468. Patented in Germany, April 26, 1890, No. 54,995; in France, June 2, 1890, No. 206,042; in Luxemburg, Dec. 6, 1890, No. 1,385; in England, Dec. 8, 1890, No. 20,002; in Switzerland, Dec. 12, 1890, No. 2,965; in Italy, Dec. 20, 1890, No. 28,844; in Norway, Jan. 21, 1891, No. 2,085; in Belgium, Nov. 29, 1891, No. 92,936; in Austria Hungary, Dec. 12, 1891, No. 39,737 and No. 65,347.
- 570,084. BUNSEN BURNER. Wm. H. Shaddock, Cleveland, Ohio. Filed Feb. 6., 1895. Serial No. 537,467.
- 570,149. SAFETY DEVICE FOR GAS-PRODUCERS. George E. Woods, New York, N. Y., assignor to Alexander C. Humphreys and Arthur G. Glasgow, same place. Filed Mar. 16, 1896. Serial No. 583,276.
- 570,263. COMBINED GAS AND STEAM ENGINE. Ransom E. Olds, Lansing, Mich. Filed Aug. 13, 1895. Serial No. 559,160.
- 570,382. APPARATUS FOR MANUFACTURING FUEL GAS. Carl Dellwik, Rogers Park, Ill. Filed Aug. 14, 1890. Serial No. 362,038.
- 570,383. GAS-GENERATING APPARATUS. Carl Dellwik, Rogers Park, Ill. Filed Aug. 14, 1890. Serial No. 362,039.

November 3.

- 570,649. GAS ENGINE. J. R. Rolfson, San Francisco, Cal. Filed May 16, 1895. Serial No. 549,522.
- 570,470. ROTARY GAS ENGINE. Louis Gathmann, Chicago, Ill. Filed June 1, 1895. Serial No. 551,427.
- 570,500. GASOLINE OR VAPOR ENGINE. Enoch Prouty, Chicago, Ill. Filed Nov. 1, 1895. Serial No. 567,600.
- 570,516. PROCESS OF AND APPARATUS FOR MAKING GAS. Levi Stevens, Trenton, N. J. Filed Dec. 13, 1895. Serial No. 572,023.

November 10.

- 571,062. APPARATUS FOR MANUFACTURING GAS. Peter Brentini, London, England. Filed Feb. 10, 1896. Serial No. 578,768. Patented in England Feb. 15, 1895.
- 571,196. GAS-MIXING APPARATUS. R. G. Kirkwood, Wheeling, W. Va. Filed Mar. 9, 1896. Serial No. 582,374.
- 571,221. GAS-GENERATING MACHINE. Jno. A. Enos, Washington, D. C. Filed Sept. 13, 1895. Serial No. 562,368.
- 571,269. PROCESS OF MANUFACTURING GAS. J. L. Janeway, Oaks, Pa. Filed Dec. 31, 1895. Serial No. 573,878.
- 571,288. ELECTRIC GAS-LIGHTING DEVICE. Ernest Schmidt, Berlin, Germany. Filed Aug. 1, 1896. Serial No. 601,351.

November 17.

- 571,372. PROCESS OF AND MACHINE FOR MAKING MANTLES OR HOODS FOR INCANDESCENT GAS LIGHTS. Philip Inch, Washington, D. C. Filed Feb. 19, 1896. Serial No. 579,886.
- 571,419. PROCESS OF MANUFACTURING HOODS OR MANTLES FOR INCANDESCENT GAS BURNERS. Wm. L. Voelker, Elizabeth, N. J. Filed May 22, 1896. Serial No. 592,664.
- 571,431. GAS BURNER. A. E. Detwiler, Milwaukee, Wis. Filed Nov. 13, 1893. Serial No. 490,742.
- 571,447. GAS ENGINE. C. A. Kunzel, Jr., Hoboken, N. J. Filed Dec. 10, 1895. Serial No. 571,686.
- 571,495. GAS ENGINE. F. C. Olin, Buffalo, N. Y. Filed Oct. 2, 1895. Serial No. 564,410.
- 571,498. GAS ENGINE. E. Rappe, Chicago, Ill. Filed Jan. 21, 1894. Serial No. 498,355.
- 571,534. GAS ENGINE. G. W. Lewis, Chicago, Ill. Filed Aug. 4, 1893. Serial No. 482,343.
- 571,558. GAS GENERATOR. J. C. Dods, St. Louis, Mo. Filed July 3, 1896. Serial No. 598,010.
- 571,576. GAS GENERATOR. J. C. Porter, St. Louis, Mo. Filed Dec. 28, 1895. Serial No. 573,637.
- 571,723. ELECTRIC GAS-LIGHTING APPARATUS. Chas. W. De Mott, Brooklyn, N. Y. Filed May 8, 1896. Serial No. 590,649.

November 24.

- 571,769. ELECTRIC IGNITING DEVICE FOR GAS-BURNERS. G. F. Krieger, Kiel, Germany. Filed May 4, 1896. Serial No. 590,188.
- 571,875. BURNER FOR ACETYLENE GAS. H. F. Fuller, Chicago, Ill. Filed May 20, 1896. Serial No. 592,273.
- 571,902. GAS BURNER. Herman Kuhfahl, New York, N. Y. Filed Mar. 20, 1896. Serial No. 584,098.
- 572,044. GAS REGULATOR. M. J. Amick, New York, N. Y. Filed Feb. 1, 1896. Serial No. 577,687.

December 1.

- 572,101. COMPOSITION OF MATERIAL FOR INCANDESCENT GAS LIGHTS. L. K. Bohm, New York, N. Y. Filed Nov. 5, 1895. Renewed Sept. 28, 1896. Serial No. 607,367.
- 572,113. ACETYLENE-GAS GENERATOR. W. P. and H. D. Hill, St. Louis, Mo. Filed Feb. 24, 1896. Serial No. 580,516.
- 572,176. APPARATUS FOR TREATING FIRE-GASES EVOLVED IN STEAM-BOILERS. Jas. Patterson, Glasgow, Scotland. Filed April 3, 1895. Serial No. 544,330.

- 572,177. APPARATUS FOR TREATING FIRE GASES. Jas. Patterson, Gourock, Scotland. Filed Aug. 31, 1895. Serial No. 561,110.
- 572,178. BLOWER FOR TREATING GASES EVOLVED IN FURNACES. Jas. Patterson, Gourock, Scotland. Filed Sept. 26, 1895. Serial No. 563,747.
- 572,184. GAS PRODUCER. J. D. Swindell, Pittsburg, Pa. Filed Feb. 7, 1896. Serial No. 578,425.
- 572 366. DIFFERENTIAL INDICATOR FOR GAS APPARATUS. Rollin Norris, Philadelphia, Pa. Filed April 13, 1896. Serial No. 587,314.

December 8.

- 572,565. BURNER FOR SPIRIT-GAS INCANDESCENT LIGHTS. Albin Perlich, Leipsic, Germany. Filed June 29, 1895. Serial No. 554,512.
- 572,703. MANUFACTURE OF ILLUMINATING GAS. C. D. Hauk, Chicago, Ill. Filed Apr. 8, 1895. Serial No. 545,018.
- 572,779. PROCESS OF AND APPARATUS FOR RECLAIMING GAS EMPLOYED IN DISPLACING LIQUIDS. J. F. Theurer, Milwaukee, Wis. Filed Dec. 4, 1893. Serial No. 492,673.
- 572,795. APPARATUS FOR MANUFACTURING GAS. G. H. Gregory, Somerville, Mass. Filed Oct. 11, 1893. Serial No. 487,874.
- 572,797. GAS-GENERATOR. J. E. Hathaway, Santa Fe Springs, Cal. Filed Jan. 8, 1896. Serial No. 574,719.
- 572,837. CARBURETER. E. I. P. Staede, Mankato, Minn. Filed Oct. 2, 1896. Serial No. 607,651.
- 572,838. AUTOMATIC GAS-PRESSURE REGULATOR. K. M. Stahl, New York, N. Y. Filed March 5, 1896. Serial No. 581,920.
- 572,900. MECHANISM FOR UNLOADING, STORING AND RELOADING COAL. Wm. A. Lathrop, Wilkes Barre, Pa. Filed April 1, 1896. Serial No. 585,820.
- 572,924. DRY GAS METER. Frank Wright, London, Eng. Filed Feb. 4, 1896. Serial No. 578,022.

December 15.

- 573,031. INCANDESCENT BURNER FOR FLUID COMBUSTIBLES. Emil H. C. Oehlmann, Berlin, Germany. Filed Feb. 4, 1896. Serial No. 578,055.
- 573,183. GAS-GENERATOR. Thomas Hennessy, Grand Forks, N. D. Filed Apr. 6, 1895. Serial No. 544,805.
- 573,205. GAS-HEATER. John W. Carter, Brooklyn, N. Y. Filed June 18, 1896. Serial No. 595,953.
- 573,209. GAS-ENGINE. Fitz E. Culver, Chicago, Ill. Filed June 20, 1896. Serial No. 596,275.
- 573,296. IGNITER FOR GAS-ENGINES. Frank J. Rettig, North Manchester, Ind. Filed Mar. 5, 1896. Serial No. 581,964.

- 573,322. VALVE DEVICE FOR GAS-ENGINES. Walker L. Crouch, New Brighton, Pa. Filed Nov. 22, 1895. Serial No. 569,830.
- 573,377. PROCESS OF CONSUMING HYDROCARBON GAS. Thomas L. Willson, New York, N. Y. Original application filed Jan. 13, 1896. Serial No. 575,370. Divided and this application filed May 29, 1896. Serial No. 593,660.
- 573,387. COMBINATION GAS AND ELECTRIC FIXTURE. James E. and Wm. M. Brown, Toledo, O. Filed July 20, 1896. Serial No. 599,805.
- 573,399. GAS-METER. John Dodd, Cleveland, O. Filed Feb. 3, 1896. Serial No. 577,886.
- 573,403. GAS OR WATER SWITCH. Samuel W. Garrison, Philadelphia, Pa. Filed May 18, 1896. Serial No. 592,046.

December 22.

- 573,513. SOLUTION FOR ILLUMINATING MANTLES FOR BUNSEN GAS-BURNERS. William and Lucy Hooker, North Fitzroy, Victoria. Filed Aug. 19, 1895. Serial No. 559,777.
- 573,578. ANNULAR LIQUID-COMBUSTIBLE BURNER FOR INCANDESCENT LIGHTS. Gerhard Ditmar, Vienna, Austria-Hungary. Filed Mar. 21, 1896. Serial No. 584,247.
- 573,628. GAS OR VAPOR ENGINE. George S. Tiffany, Highland Park, Ill. Filed Oct. 2, 1895. Serial No. 564,386.
- 573,642. SPEED REGULATOR FOR GAS ENGINES. Emil Capitaine, Frankfurt-on-the-Main, Germany. Filed May 22, 1896. Serial No. 592,591.
- 573,762. GAS-ENGINE. John Charter, Jr., Sterling, Ill. Filed May 11, 1896. Serial No. 591,121.

December 29.

- 573,863. COMBINED GAS-METER AND GAS-REGULATOR. James Coons, New York, N. Y. Filed July 10, 1896. Serial No. 598,636.
- 573,899. GAS PRODUCER AND BURNER FOR STEAM BOILERS. James Murphy, Chicago, Ill. Filed Apr. 15, 1895. Serial No. 545,711.
- 573,938. ACETYLENE-GAS GENERATOR. John W. Waite, Rock Falls, Ill. Filed Sept. 12, 1896. Serial No. 605,607.
- 573,956. AMMONIA GAS GENERATOR. Louis H. Bachmann, and Oscar R. Sulzer, Louisville, Ky. Filed May 11, 1895. Serial No. 549,005.
- 573,957. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. Francis G. Bates, Philadelphia, Pa. Filed May 7, 1896. Serial No. 590,529.
- 573,958. GAS APPARATUS. Francis G. Bates, Philadelphia, Pa. Filed June 8, 1896. Serial No. 594,632.

lxxxiii

- 573,989. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. Maurice Lorois, Nantes, France, and Francis G. Bates, Philadelphia, Pa. Filed June 13, 1896. Serial No. 595,496.
- 573,996. GAS-DISTRIBUTING APPARATUS. Robert L. Owen, Muscogee, Ind. Ter. Filed Mar. 3, 1896. Serial No. 581,722.
- 574,018. GAS BURNER. John F. Burgess, London, Eng. Filed July 1, 1896. Serial No. 597,690. Patented in Eng. Dec. 3, 1895. No. 23,150.
- 574,183. MIXER FOR GAS ENGINES. Frank M. Underwood, Upper Sandusky, Ohio. Filed Mar. 14, 1895. Serial No. 541,704.
- 574,311. EXPANSION GAS ENGINE. John W. Eisenhuth, San Francisco, Cal. Filed Oct. 5, 1893. Renewed May 7, 1896. Serial No. 590,630.

January 5, 1897.

- 574,535. GAS ENGINE. Carl L. Grohmann, Hartford, Conn. Filed Mar. 31, 1896. Serial No. 585,647.
- 574,595. AIR AND GAS MIXER. Nathan White, Pasadena, Cal., assignor to Edith White. Filed Oct. 16, 1896. Serial No. 609,142.
- 574,601. ACETYLENE-GAS-GENERATING LAMP. Henri E. Casgrain, Quebec, Canada. Filed May 20, 1896. Serial No. 592,284.
- 574,610. GAS ENGINE. Gustaf Joranson, Berwyn, Ill. Filed Sept. 20, 1895. Serial No. 563,053.
- 574,614. GAS ENGINE ATTACHMENT. George W. Lamos, Fort Madison, Iowa. Filed April 30, 1896. Serial No. 589,705.
- 574,640. BOULEVARD LAMP. Aaron P. Storrs, Owego, N. Y. Filed Dec. 12, 1895. Serial No. 571,905.
- 574,670. GAS ENGINE. Walker L. Crouch, New Brighton, Pa. Filed Nov. 30, 1895. Serial No. 570,665.
- 574,683. APPARATUS FOR WASHING GAS. Percy F. Holmes, Huddersfield, Eng. Filed May 16, 1896. Serial No. 591,772. Patented in England Mar. 11, 1895. No. 5,113.
- 574,723. GAS OR OIL ENGINE. Eugene Fessard, Poissy, France. Filed Feb. 26, 1896. Serial No. 580,799. Patented in France Apr. 13, 1895, No. 246,621; in Belgium Oct. 14, 1895, No. 117,872; in England Nov. 13, 1895, No. 21,574, and in Austria Dec. 20, 1895, No. 45/4,984.
- 574,762. OIL, GAS OR LIKE ENGINE. Walter Rowbotham, Birmingham, England. Filed Apr. 30, 1896. Serial No. 589,774.
- 574,805. INCANDESCENT BURNER. Ottmar Kern, Paris, France. Filed Sept. 8, 1896. Serial No. 605,180.
- 574,862. MANTLE OR HOOD FOR INCANDESCENT GAS-LAMPS. Gerrit Van Deth, New York, N. Y. Filed Mar. 28, 1895. Serial No. 543,578.

January 12.

- 574,907. GAS-FIXTURE. Edward A. C. Kaysel, New York, N. Y. Filed June 24, 1896. Serial No. 596,684.

- 575,051. GAS-STOVE BURNER. Alfred E. Detwiler, Milwaukee, Wis. Filed Oct. 26, 1891. Serial No. 409,767.
- 575,052. GAS-STOVE BURNER. Alfred E. Detwiler, Chicago, Ill. Filed May 22, 1896. Serial No. 592,525.
- 575,137. PROCESS OF AND BURNER FOR PRODUCING INCANDESCENCE. Gerrit Van Deth, New York, N. Y. Filed Jan. 29th, 1896. Serial No. 577,326.
- 575,183. BURNER FOR INCANDESCENT GAS-LIGHTS. Richard Violet, Berlin, Germany, assignor to Louis H. Hall, Philadelphia, Pa. Filed Jan. 2, 1896. Serial No. 574,137. Patented in Belgium, Feb. 16, 1895, No. 114,140; and in Luxemburg Feb. 20, 1895. No. 2,241.
- 575,194. METHOD OF MAKING GAS-INCANDESCENT MANTLES. Robt. Alexander, Geo. F. Payne, and Charles H. Mann, Philadelphia, Pa., assignors to Louis H. Hall, same place. Filed March 28, 1896. Serial No. 585,253.
- 575,261. GAS-INCANDESCENT. Robert Moscheles, Berlin, Germany, assignor to Louis H. Hall, Philadelphia, Pa. Filed July 3, 1896. Serial No. 598,002.
- 575,262. GAS-INCANDESCENT. Robert Moscheles, Berlin, Germany, assignor to Louis H. Hall, Philadelphia, Pa. Original application filed July 3, 1896. Serial No. 598,002. Divided and this application filed Nov. 17, 1896. Serial No. 612,497.
- 575,263. GAS-INCANDESCENT. Robert Moscheles, Berlin, Germany, assignor to Louis H. Hall, Philadelphia, Pa. Original application filed July 3, 1896. Serial No. 598,002. Divided and this application filed Nov. 17, 1896. Serial No. 612,498.
- 575,281. APPARATUS FOR GENERATING ACETYLENE GAS. Leroy S. Buffington, Minneapolis, Minn. Filed Feb. 21, 1896. Serial No. 580,182.
- 575,305. GAS PRODUCER. Ralph L. Morgan, Worcester, Mass., assignor to the Morgan Construction Co., same place. Filed Mar. 8, 1895. Serial No. 541,037.

January 19.

- 575,318. GAS-BURNER. John F. Barker, Springfield, Mass, assignor to the Gilbert & Barker Manufacturing Co., of Massachusetts. Filed Aug. 7, 1896. Serial No. 601,937.
- 575,326. GAS-ENGINE. Harry S. Bristol, Chicago, Ill. Filed Sept. 7, 1895. Serial No. 561,725.
- 575,441. INCANDESCENT GAS-LAMP OR BURNER. Harry Lee, Liverpool, England. Filed Nov. 30, 1895. Serial No. 570,654. Patented in England, Jan. 25, 1894. No. 1,605.
- 575,474. GAS-GENERATOR FOR ACETYLENE. Henry F. Fuller, Chicago, Ill., assignor to the Walmsley, Fuller & Company, same place. Filed Nov. 2, 1896. Serial No. 610,850.

lxxxv

- 575,502. GAS-ENGINE. Walker L. Crouch, New Brighton, Pa., assignor to the Pierce-Crouch Engine Company, same place. Filed Nov. 22, 1895. Serial No. 569,829.
- 575,517. ROTARY GAS-ENGINE. John D. Blagden, Wood's Holl, Mass. Filed Aug. 12, 1896. Serial No. 602,502.
- 575,560. CARBURETED-WATER-GAS APPARATUS. Walter R. Addicks, Brookline, Mass. Filed Nov. 15, 1895. Serial No. 569,040.
- 575,625. METHOD OF AND APPARATUS FOR PRODUCING WATER-GAS. Walter R. Addicks, Boston, Mass. Filed Aug. 19, 1893. Serial No. 483,499.
- 575,661. GAS OR OIL ENGINE. Walter F. Trotter, Marshalltown, Iowa. Filed May 18, 1896. Serial No. 591,919.
- 575,668. ILLUMINANT FOR INCANDESCENT LAMPS. Alexander de Lodyguine, Pittsburg, Pa. Filed Apr. 10, 1894. Serial No. 507,010.
- 575,672. PREPAYMENT ATTACHMENT FOR METERS. Hugh W. Williams, San Leandro, Cal. Filed Apr. 17, 1896. Serial No. 587,907.
- 575,677. METHOD OF AND APPARATUS FOR GENERATING ACETYLENE GAS. Henry F. Fuller, Chicago, Ill., assignor to the Walmsley, Fuller & Co., same place. Filed Nov. 2, 1896. Serial No. 610,852.

January 26.

- 575,720. GAS-ENGINE.— Joseph Ledent, Baltimore, Md. Filed July 1, 1896. Serial No. 597,660.
- 575,877. APPARATUS FOR PURIFYING SMOKE OR GASES. Harry R. Chubb, London, England. Filed May 11, 1896. Serial No. 591,062.
- 575,878. GAS-ENGINE. Frederick W. Coen, Chicago, Ill. Filed May 14, 1896. Serial No. 591,465.
- 575,884. APPARATUS FOR PRODUCING ACETYLENE GAS. Maurice C. A. Fourchotte, Paris, France. Filed June 27, 1896. Serial No. 597,114.
- 575,885. APPARATUS FOR PRODUCING ACETYLENE GAS. Maurice C. A. Fourchotte, Paris, France. Filed June 27, 1896. Serial No. 597,115.
- 575,914. GAS-LAMP. Aaron P. Storrs, Owego, N. Y. Filed June 15, 1896. Serial No. 595,515.
- 575,955. APPARATUS FOR MANUFACTURING GAS. John L. Janeway, Oaks, Pa.; Price W. Janeway and Thomas L. Hodge, administrators of said John L. Janeway, deceased, assignors to the Phoenix Gas and Improvement Company, Philadelphia, Pa. Filed Aug. 27, 1895. Serial No. 560,660.

February 2.

- 576,170. APPARATUS FOR MANUFACTURING GAS. John L. Stewart, San Francisco, Cal., assignor to Thomas A. McIntyre, New York, N. Y. Filed Jan. 13, 1893. Serial No. 458,304.

- 576,216. GAS GRATE FOR PARLORS, ETC. Peter I. Miller, Cleveland, Ohio. Filed July 16, 1896. Serial No. 599,378.
- 576,227. LIGHTING APPARATUS FOR GAS-LAMPS. Wilhelm Ritter, Cologne, Germany. Filed Mar. 11, 1895. Serial No. 541,292.
- 576,259. GAS TIP OR NOZZLE. James H. Diamond, Allegheny, Pa., assignor to Mary B. McClelland, same place. Filed July 10, 1895. Serial No. 555,591.
- 576,282. OIL-GAS GENERATOR. Willard A. Smith, Providence, R. I. Filed Nov. 6, 1895. Serial No. 568,109.
- 576,311. GAS-BURNER. Edward Heyman and Frank W. Heyman, Boston, Mass. Filed Feb. 19, 1896. Serial No. 579,888.
- 576,350. GAS STOVE. Hiram M. Murk, Columbus, Ohio. Filed April 27, 1896. Serial No. 589,272.
- 576,386. ACETYLENE-GAS GENERATOR. Emil P. Voisard, Chicago, Ill. Filed Sept. 15, 1896. Serial No. 605,867.
- 576,430. EXPLOSIVE-ENGINE. Franz Burger, Fort Wayne, Ind., assignor of three-fourths to Henry M. Williams, same place. Filed Mar. 23, 1895. Serial No. 542,976.
- 576,499. GAS-APPARATUS. George F. Ransom, Milwaukee, Wis., assignor, by direct and mesne assignments, of three-fourths to George F. Ransom, Jr., same place, and Lucas D. Dorschel, Chilton, Wis. Filed Dec. 27, 1895. Serial No. 573,553.
- 576,523. PETROLEUM INCANDESCENT BURNER. George Washington, Brussels, Belgium, assignor to J. Wesley Allison, New York, N. Y. Filed Sept. 17, 1896. Serial No. 606,164.
- 576,524. PETROLEUM INCANDESCENT LIGHTING. George Washington, Brussels, Belgium. Filed Dec. 12, 1896. Serial No. 615,471.

February 9.

- 576,529. APPARATUS FOR MANUFACTURING GAS. Walter R. Addicks, Brookline, Mass. Filed Sept. 3, 1896. Serial No. 604,733.
- 576,585. APPARATUS FOR GENERATING ACETYLENE GAS. Moses W. Kidder, Lincoln, Mass., assignor to Person Noyes, Lowell, Mass. Filed Feb. 1, 1896. Serial No. 577,719.
- 576,604. GAS ENGINE. Lewis H. Nash, South Norwalk, Conn., assignor to the National Meter Co., New York, N. Y. Original application filed May 22, 1890. Serial No. 352,736. Divided and this application filed Aug. 16, 1890. Serial No. 362,194.
- 576,668. GAS-BURNER TIP. Isidor Gloo, Plymouth, Pa. Filed June 19, 1896. Serial No. 596,104.
- 576,669. FASTENING FOR GAS-COCKS, ETC. John A. Hamilton, New York, N. Y. Filed June 11, 1896. Serial No. 595,075.

lxxxvii

- 576,682. GAS-BURNER FOR ACETYLENE. Max Levy, Philadelphia, Pa. Filed Nov. 14, 1895. Serial No. 568,971.
- 576,774. FIREPLACE-GAS-HEATER. Morris I. Cohen, Chicago, Ill. Filed Jan. 18, 1896. Serial No. 575,984.
- 576,795. GAS-BURNER ATTACHMENT FOR RANGES. Louis Stockstrom, St. Louis, Mo., assignor one-half to Charles A. Stockstrom, same place, Filed Jan. 27, 1896. Serial No. 576,975.
- 576,801. PROCESS OF AND APPARATUS FOR MANUFACTURING GAS. Francis G. Bates, Philadelphia, Pa. Filed June 4, 1896. Serial No. 594,303.
- 576,819. GAS-BURNER. William H. Paine, Providence, R. I. Filed Nov. 6, 1896. Serial No. 611,224.
- 576,826. GENERATOR FOR MAKING ACETYLENE GAS. Henry C. Sergeant, Westfield, N. J. Filed Mar. 13, 1896. Serial No. 583,017.
- 576,827. ACETYLENE-GAS HOLDER. Henry C. Sergeant, Westfield, N. J. Filed Mar. 13, 1896. Serial No. 583,018.
- 576,893. ACETYLENE-GAS GENERATOR. Delbert J. Reynolds, Winnebago, City, Minn., assignor to the Finkler-Reynolds Company, Chicago, Ill. Filed Oct. 7, 1896. Serial No. 608,124.
- 576,895. INSECT-GUARD FOR LAMP-BURNERS. Robert P. Robinson, Waterbury, Conn., assignor to The Scovill Manufacturing Company, same place. Filed Aug. 31, 1896. Serial No. 604,406.
- 576,955. METHOD OF AND APPARATUS FOR GENERATING GAS. James A. Deuther, Boston, Mass. Filed July 13, 1896. Serial No. 599,025. Patented in England Sept. 17, 1896. No. 20,599.
- 576,956. LOCKING DEVICE FOR GAS-COCKS. John Doyle, New York, N. Y. Filed Apr. 18, 1896. Serial No. 588,148.
- 576,961. COIN-CONTROLLED MECHANISM FOR GAS-METERS. George R. French, Boston, Mass.; Sarah Ann French, administratrix of said George R. French, deceased. Filed Dec. 17, 1895. Serial No. 572,442.

February 16.

- 577,051. ACETYLENE-GAS GENERATOR. Charles Matthews, Jr., Chicago, Ill. Filed Oct. 14, 1896. Serial No. 608,807.
- 577,158. ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES. William F. Davis, Waterloo, Iowa, assignor to the Davis Gasoline Engine Co., same place. Filed Sept. 24, 1896. Serial No. 606,875.
- 577,160. GAS-MOTOR. William Donaldson, London, England. Filed Oct. 11, 1895. Serial No. 565,387. Patented in England Apr. 4, 1895. No. 6,972.
- 577,167. PORTABLE HYDROCARBON-ENGINE. Wilhelm Maybach, Cannstadt, Germany. Filed July 11, 1896. Serial No. 598,850.

- 577,187. MANUFACTURE OF MANTLES FOR INCANDESCENT GAS-BURNERS. Leopold Hartman, New York, N. Y. Filed Nov. 11, 1896. Serial No. 611,776.
- 577,215. COIN-CONTROLLED GAS OR LIQUID VENDING MACHINE. Wesley Webber, New York, N. Y. Filed Feb. 3, 1896. Serial No. 577,814.
- 577,216. COIN-CONTROLLED GAS-VENDING MACHINE. Wesley Webber, New York, N. Y. Filed Feb. 19, 1896. Serial No. 579,836.
- 577,279. ELECTRIC GAS-LIGHTER. James T. Armstrong and Axel Orling, London, England. Filed Nov. 19, 1896. Serial No. 612,695.
- 577,289. FLUID-PRESSURE REGULATOR. William C. Downward, Wilmington, Del. Filed Nov. 5, 1896. Serial No. 611,105.

February 23.

- 577,513. GAS-STOVE. Lazard Kahn, Hamilton, Ohio, assignor to F. & L. Kahn & Bros., same place. Filed Jan. 11, 1895. Serial No. 534,519.
- 577,567. GAS-ENGINE. Luther H. Wattles, Providence, R. I., assignor by direct and mesne assignments, of three-fourths to William B. Sherman, same place, and Byron C. Davis, Brooklyn, N. Y. Filed Dec. 7, 1895. Serial No. 571,337.
- 577,606. PRODUCTION OF STEAM FOR USE IN GAS-PRODUCERS. Ludwig Mond, Northwich, England. Filed Oct. 5, 1895. Serial No. 564,718.
- 577,677. MEANS OR APPARATUS FOR BURNING ILLUMINATING GAS. Theodore Birnbaum, London, England. Filed Aug. 17, 1896. Serial No. 603,011.
- 577,696. MANTLE-PROTECTOR FOR INCANDESCENT GAS-BURNERS. Louis Teichmann, Berlin, Germany. Filed June 1, 1896. Serial No. 593,830.
- 577,697. GAS-RETORT LID. Thomas B. Tinney, Philadelphia, Pa., assignor of one-half to William McDonald, same place. Filed May 22, 1896. Serial No. 592,574.
- 577,706. ACETYLENE-GAS GENERATOR. Guy S. Archer and Charles F. Burrington, Cherokee, Iowa. Filed Apr. 15, 1896. Serial No. 587,643.
- 577,739. DEVICE FOR REGULATING QUALITY OF GAS. Edward J. Frost, Philadelphia, Pa., and Benjamin Middleditch, Detroit, Mich., assignors to Joseph H. Berry, Detroit, Mich. Filed June 13, 1895. Serial No. 552,643.
- 577,762. APPARATUS FOR INCREASING CANDLE-POWER OF GAS. Robert S. Lawrence, Chicago, Ill. Filed May 2, 1896. Serial No. 589,954.
- 577,803. PROCESS OF PRODUCING AND CONSUMING HYDROCARBON GAS. Thomas L. Willson, New York, N. Y., assignor to the Electro Gas Company of West Virginia. Original application filed Jan. 9, 1894. Serial No. 517,008. Divided and this application filed Jan. 13, 1896. Serial No. 575,370.

lxxxix

- 577,828. INCANDESCENT GAS LAMP. Julius Moeller, London, England. assignor to the Welsbach Light Company, Gloucester City, N. J. Filed May 16, 1896. Serial No. 591,768.

March 2.

- 577,884. GAS-LIGHTING APPARATUS. Thomas Rowan, London, England. Filed Dec. 26, 1895. Serial No. 573,342.
- 577,898. EXPLOSIVE-ENGINE. Jesse Walrath, Racine, Wis. Filed Dec. 9, 1895. Serial No. 571,507.
- 577,992. GAS-GOVERNOR. Charles A. Switzer, Los Angeles, Cal. Filed July 20, 1896. Serial No. 599,905.
- 578,055. ACETYLENE-GAS GENERATOR. Henry F. Fuller, Chicago, Ill., assignor to the Walmsley, Fuller & Company, same place. Filed Nov. 2, 1896. Serial No. 610,851.
- 578,071. GAS-BURNER. Samuel Bernheim, New York, N. Y. Filed Jan. 2, 1896. Serial No. 574,176.
- 578,112. GAS-ENGINE. Lewis H. Nash, South Norwalk, Conn., assignor to the National Meter Company, New York, N. Y. Filed June 17, 1891. Serial No. 396,561.
- 578,212. GAS-REGULATOR FOR WELSBACH BURNERS. Oren R. Cline, El Dorado, Kans. Filed June 9, 1896. Serial No. 594,819.
- 578,266. OIL, GAS OR LIKE ENGINE. Walter Rowbotham, Birmingham, England. Filed April 30, 1896. Serial No. 589,776.

March 9.

- 578,347. GAS-GENERATING MACHINE. Francis L. Mitchell, Dallas, Tex. Filed Apr. 4, 1896. Serial No. 586,242.
- 578,377. EXPLOSIVE-ENGINE. Jesse Walrath, Racine, Wis. Filed Jan. 6, 1896. Serial No. 574,418.
- 578,420. ELECTRIC GAS LIGHTER. Frederick N. Pike, New York, N. Y., assignor of one-third to Edward N. Dickerson, same place. Filed Mar. 11, 1896. Serial No. 582,715.
- 578,621. GAS-PRESSURE REGULATOR. Charles E. Belt, Baltimore, Md. Filed Aug. 5, 1896. Serial No. 601,719.
- 578,685. PROCESS OF AND APPARATUS FOR PRODUCING CALCIUM CARBIDE. Edwin R. Whitney, Manchester, N. H. Filed May 25, 1896. Serial No. 592,999.

March 16.

- 578,711. BY-PASS VALVE FOR WELSBACH OR OTHER INCANDESCENT GAS-BURNERS. George S. Barrows, Philadelphia, Pa., assignor to the Welsbach Light Company, Gloucester City, N. J. Filed Mar. 26, 1896. Serial No. 548,904.

- 578,735. INCANDESCENT-LIGHT FIXTURE FOR RAILWAY CARS, ETC. Simeon E. Farraday, Gloucester City, N. J., assignor to the Welsbach Light Company, same place. Filed July 22, 1896. Serial No. 600,112.
- 578,841. PROCESS OF AND APPARATUS FOR HEMMING ENDS OF INCANDESCENT MANTLES. Emil Skriwan, Vienna, Austria-Hungary. Filed Dec. 18, 1896. Serial No. 616,172.
- 578,847. ACETYLENE-GAS GENERATOR. Clementina H. Wilcox, Minneapolis, Minn. Filed Dec. 5, 1896. Serial No. 614,594.
- 578,863. GAS-METER. Elias B. De La Matyr, San Francisco, Cal. Filed Mar. 27, 1896. Serial No. 585,048.
- 578,864. GAS-METER. Elias B. De La Matyr, San Francisco, Cal. Filed July 1, 1896. Serial No. 597,708.
- 578,865. GAS-METER. Elias B. De La Matyr, San Francisco, Cal. Filed Nov. 15, 1895. Renewed July 1, 1896. Serial No. 597,786.
- 578,934. GAS-LIGHTING. Joseph B. de Léry, New York, N. Y. Filed June 29, 1896. Serial No. 597,405.
- 578,972. ACETYLENE-GAS GENERATOR. James H. Couper, Atlanta, Ga., assignor of one-half to John M. Sitton and Thomas V. Hubbard, same place. Filed Nov. 4, 1896. Serial No. 611,077.
- 579,068. HYDROCARBON-ENGINE. Edward Merry, Springfield, Mass., assignor of one-half to George D. Lytle, same place. Filed Feb. 8, 1896. Serial No. 578,454.
- 579,110. APPARATUS FOR MANUFACTURING GAS. William H. Harris, Washington, D. C., assignor to William A. Milliken, same place. Filed May 9, 1895. Serial No. 548,779.

March 23.

- 579,249. ELECTRICAL GAS-COCK. Frank W. Ackerman, Corning, N. Y., assignor of one-half to Frank P. Foster, same place. Filed July 11, 1896. Serial No. 598,849.
- 579,318. GAS-BURNER AND MEANS FOR ADMITTING GAS AND AIR THERETO. John E. Dame, Brooklyn, N. Y. Filed May 23, 1896. Serial No. 592,815.
- 579,378. GAS-ENGINE. Leon Benier, Paris, France, assignor to the Compagnie Générale des Moteurs Gazogènes Système Bénier, same place. Filed Feb. 17, 1894. Serial No. 500,513. Patented in France, Dec. 29, 1893, No. 235,146; in Belgium Jan. 19, 1894, No. 108,139; in Switzerland Jan. 22, 1894. No. 7 897; in England Jan. 24, 1894, No. 1,581; in Germany Jan. 28, 1894, No. 77,835; in Hungary, Feb. 18, 1894, No. 42; in Spain Feb. 26, 1894, No. 15,400; in Austria, Mar. 1, 1894, No. 221; in Italy Mar. 30, 1894, No. 33,623; in Portugal Nov. 28, 1894, No. 2,043; in Luxemburg May 18, 1895, No. 2,309; in Tunis May 26, 1895, No. 152; and in Turkey Sept. 27, 1895, No. 465.

- 579,408. GAS-MIXER. Lewis J. Rice, Indianapolis, Ind. Filed Feb. 7, 1896. Serial No. 578,400.
- 579,554. GAS-MOTOR. Edward W. Blum, Cincinnati, Ohio, assignor of one-half to John H. Stricker, Anderson, Ind. Filed Dec. 26, 1896. Serial No. 573,306.

March 30.

- 579,657. HYDROCARBON-BURNER. Victor H. Slinack, Philadelphia, Pa., assignor to the Pennsylvania Globe Gas Light Company, of Pennsylvania. Filed Apr. 17, 1896. Serial No. 587,917.
- 579,687. REGENERATIVE BURNER. William R. Swift and Thomas Gordon, New York, N. Y., assignors to the Gordon-Mitchell Gas Lamp Company, same place. Filed April 13, 1893. Serial No. 470,201.
- 579,689. ACETYLENE-GAS-GENERATING APPARATUS. Joseph A. Vincent, Philadelphia, Pa., assignor to the Electro Gas Company of West Virginia. Filed May 7, 1896. Serial No. 590,520.
- 579,702. ACETYLENE-GAS-PRODUCING APPARATUS. Edward N. Dickerson, New York, N. Y. Original application filed Jan. 3, 1896. Serial No. 574,205. Divided and this application filed May 25, 1896. Serial No. 592,980.
- 579,740. FIREPLACE GAS HEATER. Morris I. Cohn, Chicago, Ill. Filed Jan. 18, 1896. Serial No. 575,983.
- 579,789. GAS-ENGINE. Peter T. Coffield, Dayton, Ohio, assignor to W. P. Callahan & Co., same place. Filed Nov. 16, 1896. Serial No. 612,210.
- 579,860. GAS-ENGINE. Oliver Colborne, Chicago, Ill. Filed Dec. 23, 1895. Serial No. 573,040.
- 579,871. PREPAYMENT GAS-METER. John Hawkyard, Saddleworth, England, assignor to Joseph Braddock, Oldham, England. Filed May 19, 1896. Serial No. 592,143.
- 579,921. IGNITING APPARATUS FOR INTERNAL-COMBUSTION ENGINES. George L. Woodworth, Stanford University, Cal. Filed May 12, 1896. Serial No. 591,313.

April 6.

- 580,020. PROCESS OF PRODUCING GAS. Elihu Thomson, Swampscott, Mass. Filed Dec. 11, 1896. Serial No. 615,318.
- 580,074. GAS-BURNER. William B. Williams, Leigh, England. Filed Feb. 20, 1896. Serial No. 580,120. Patented in England, Apr. 18, 1893. No. 7,831.

- 580,090. GAS OR GASOLINE ENGINE. James G. Lewis, Baltimore, Md., assignor by direct and mesne assignments, to the Lewis Gas Motor Company of Baltimore City, of Maryland. Filed July 29, 1895. Serial No. 557,471.
- 580,096. GAS-STOVE. William Tracy, Leavenworth, Kans., and Kerr M. Mitchell, St. Joseph, Mo. Filed Dec. 19, 1895. Serial No. 572,713.
- 580,113. BURNER. Ernst Linder, New York, N. Y. Filed Dec. 23, 1896. Serial No. 616,692.
- 580,126. BURNER FOR ACETYLENE GAS. Henry F. Fuller, Chicago, Ill., assignor to the Walmsley, Fuller & Co., same place. Filed May 20, 1896. Serial No. 592,272.
- 580,147. PROCESS OF AND APPARATUS FOR DEHYDRATING GAS. Jacob S. Smith, Chicago, Ill. Filed July 9, 1896. Serial No. 598,607.
- 580,172. GAS OR OTHER EXPLOSIVE ENGINE. Mildred Blakey, Pittsburg, Pa. Filed July 10, 1896. Serial No. 598,637.
- 580,247. GAS-PRODUCER. Per T. Berg and Niven McConnell, Munhall, Pa. Filed May 8, 1896. Serial No. 590,690.
- 580,298. IGNITER OR GAS-LIGHTER. William Trabue, Louisville, Ky., assignor to Curran Pope, same place. Filed June 26, 1896. Serial No. 596,986.
- 580,360. FURNACE FOR BURNING HYDROCARBONS. Chas. H. Bachy, Girault, Belgium. Filed Oct. 19, 1895. Serial No. 566,210. Patented in France Aug. 17, 1894, No. 240,805; in Belgium Dec. 6, 1894, No. 107,761; in Hungary, Feb. 2, 1895, No. 2,111; in Italy, Feb. 18, 1895, No. 48, and in Austria, Feb. 5, 1896, No. 2,919.
- 580,387. EXPLOSIVE-ENGINE. George H. Ellis and John F. Steward, Chicago, Ill. Filed Dec. 26, 1895. Serial No. 573,312.
- 580,444. GAS-ENGINE. Hurbert C. Baker, Hartford, Conn. Filed July 9, 1896. Serial No. 598,579.
- 580,445. MOTOR-ENGINE. Francis G. Bates and Frank H. Bates, Philadelphia, Pa. Filed Dec. 15, 1896. Serial No. 615,762.
- 580,568. PROCESS OF MANUFACTURING FUEL. Frank Batter, Marshfield, Oreg. Filed Mar. 16, 1896. Serial No. 583,347.
- 580,624. ACETYLENE-GAS-GENERATING APPARATUS. Edward C. Napheys, Philadelphia, Pa., assignor to the Electro Gas Company of West Virginia. Filed May 21, 1896. Serial No. 592,435.
- 580,626. MEANS FOR TRANSPORTING WELSBACH OR OTHER MANTLES. Townsend Stites, Gloucester City, N. J., assignor to the Welsbach Light Company, same place. Filed July 23, 1896. Serial No. 600,195.
- 580,650. ACETYLENE-GAS GENERATOR. Delbert J. Reynolds, Winnebago, Minn., assignor, by direct and mesne assignments, to the Finkler-Reynolds Company, Chicago, Ill. Filed July 17, 1896. Serial No. 599,518.

- 580,689. PROTECTIVE BUSHING AND HOLDER FOR RUBBER GAS-BAGS. John Hearne and Elmer E. Cisco, Brooklyn, N. Y. Filed July 27, 1896. Serial No. 600,678.
- 580,810. GAS-LAMP. Thomas C. J. Thomas and William M. Still, London, England. Filed Feb. 25, 1896. Serial No. 580,635. Patented in England, Jan. 7, 1895, No. 435; in France Jan. 31, 1896, No. 253,602; in Belgium Feb. 15, 1896, No. 119,659; in Austria June 1, 1896, No. 462,163, and in India July 1, 1896, No. 76, and Nov. 3, 1896, No. 218.

April 20.

- 581,020. ACETYLENE-GAS-GENERATING LAMP. William H. Dennis, Minneapolis, Minn. Filed Dec. 15, 1896. Serial No. 615,830.
- 581,025. GAS-BURNER. Emanuel G. Golder, Lake View, N. J. Filed Dec. 10, 1896. Serial No. 615,107.
- 581,090. INCANDESCENT LAMP FOR LIQUID HYDROCARBONS. Konrad Trobach, Pankow, Germany. Filed Sept. 16, 1895. Serial No. 562,682.
- 581,117. GAS BURNER. Thomas Holliday, Huddersfield, England. Filed Oct. 23, 1895. Serial No. 566,584.
- 581,203. APPARATUS FOR MANUFACTURING GAS. Alexander M. Hay, Duluth, Minn. Filed Mar. 25, 1896. Serial No. 584,882.

April 27.

- 581,327. ELECTRIC GAS-LIGHTER. Lewis L. Borradaile, Philadelphia, Pa., assignor of one-half to Joseph Lindsey Durnell, same place. Filed Dec. 23, 1896. Serial No. 616,723.
- 581,364. MANTLE OR HOOD FOR INCANDESCENT GAS-LIGHTS. Ernest Nienstaedt, New York, N. Y., assignor to the Apollo Incandescent Gas Light Company, same place. Filed Mar. 12, 1897. Serial No. 627,213.
- 581,385. GAS OR VAPOR ENGINE. Eugene P. Woillard, Sugden, Fla. Filed May 14, 1896. Serial No. 591,530.
- 581,666. APPARATUS FOR CARBURETING WATER-GAS. Rollin Norris, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place. Filed Aug. 13, 1895. Renewed Mar. 12, 1897. Serial No. 627,223.
- 581,683. GAS-ENGINE. William O. Worth, Benton Harbor, Mich. Filed June 17, 1895. Serial No. 553,091.

May 4.

- 581,699. APPARATUS FOR GENERATING ACETYLENE GAS. Albert F. Doddridge, Chicago, Ill., assignor to James E. Merritt, same place. Filed Mar. 18, 1896. Serial No. 583,677.

- 581,707. AUTOMATIC GAS-LIGHTING DEVICE. Adolf Franke, Berlin, Germany, assignor to the Deutsche Gas-Selbstzönder-Gesellschaft mit Beschränkter Haftung, same place. Filed Jan. 2, 1897. Serial No. 617,790.
- 581,783. GAS-ENGINE. Thomas Small, Camden, N. J., assignor to George J. Richardson, trustee, Philadelphia, Pa. Filed Apr. 11, 1896. Serial No. 587,184.
- 581,784. GAS-ENGINE. Thomas Small, Camden, N. J., assignor to George J. Richardson, trustee, Philadelphia, Pa. Filed Apr. 11, 1896. Serial No. 587,186.
- 581,843. AIR-HOLDER FOR GAS APPARATUS. James M. Bois, Aurora, N. Y. Filed Mar. 17, 1896. Serial No. 583,619.
- 581,866. SUPPORT FOR MANTLES USED IN LIGHTING BY INCANDESCENCE. Joseph B. de Léry, New York, N. Y. Filed May 8, 1896. Serial No. 590,660.
- 581,867. INCANDESCENT GAS-BURNER. Joseph B. de Léry, New York, N. Y. Filed May 15, 1896. Serial No. 591,601.
- 581,894. HOOD FOR INCANDESCENT GAS-LAMPS. William L. Voelker, Elizabeth, N. J., assignor, by mesne assignments, to the Voelker Light Company, of New Jersey. Filed Oct. 14, 1895. Serial No. 565,681.
- 581,909. METHOD OF AND APPARATUS FOR CARBURETING WATER-GAS. Arthur G. Glasgow and Alexander C. Humphreys, New York, N. Y. Filed Aug. 6, 1895. Serial No. 558,391.
- 581,911. PROCESS OF AND APPARATUS FOR MAKING CARBURETED WATER-GAS. Alexander C. Humphreys and Arthur G. Glasgow, New York, N. Y. Filed July 10, 1895. Serial No. 555,489.
- 581,930. GAS-MIXER. George Alderson, La Salle, Ill., assignor to Charles Brunner, Peru, Ill. Filed May 6, 1895. Serial No. 548,285.
- 582,044. APPARATUS FOR MANUFACTURING GAS. Augustus S. Cooper, Santa Barbara, Cal. Filed May 4, 1896. Serial No. 590,157.
- 582,073. GAS OR OIL ENGINE. Frank S. Mead, Montreal, Canada. Filed Sept. 23, 1895. Serial No. 563,450.
- 582,085. ELECTRIC GAS IGNITER. Frederick N. Pike, New York, N. Y., assignor to Harry T. Johnson, Jersey City, N. J. Filed July 8, 1896. Serial No. 598,389.
- 582,108. EXPLOSIVE-ENGINE. Alexander Winton, Cleveland, Ohio. Filed Mar. 18, 1896. Serial No. 583,840.

May 11.

- 582,175. AUTOMATIC GAS-LIGHTING DEVICE. Jean Canellopoulos, Paris, France. Filed Jan. 2, 1897. Serial No. 617,776.
- 582,258. LEAD-LINED PIPE-JOINT. Douglas G. Brighton and Edwin M. Venning, London, England. Filed Aug. 21, 1895. Serial No. 560,048.

- 582,267. SELF-IGNITING GAS-BURNER. Jean M. Canellopoulos, Paris, France. Filed Mar. 9, 1897. Serial No. 626,656. Patented in Luxemburg, Dec. 18, 1896. No. 2,700.
- 582,271. OIL OR GAS ENGINE. Henry T. Dawson, London, England. Filed Mar. 9, 1896. Serial No. 582,424.
- 582,274. APPARATUS FOR GASIFYING AND CONTROLLING LIQUEFIED OR COMPRESSED GAS. Edward N. Dickerson and Julius J. Suckert, New York, N. Y., assigns to the United States Acetylene Liquefaction Company of New York. Filed Mar. 4, 1896. Serial No. 581,842.
- 582,297. SHUT-OFF ATTACHMENT FOR GAS-JETS, ETC. Charles Mellish, Brooklyn, N. Y., assignor of one-half to Leon L. Burr, same place. Filed Mar. 19, 1896. Serial No. 583,963.
- 582,443. GAS-LAMP. Aaron P. Storrs, Owego, N. Y. Filed Oct. 5, 1896. Serial No. 607,874.
- 582,459. INCANDESCENT GAS-BURNER AND MANTLE. William H. Cottingham, Milwaukee, Wis., assignor to Frederick R. Foster, same place. Filed Apr. 3, 1896. Serial No. 586,477.
- 582,529. COMBINED GAS-PRODUCING AND AIR-HEATING APPARATUS. Alexander M. Hay, Duluth, Minn., and John B. Archer, Washington, D. C., assigns of one-half to John Hay, London, England. Filed Apr. 24, 1896. Serial No. 588,954.
- 582,532. IGNITER FOR GAS ENGINES. John W. Lambert, Anderson, Ind. Filed June 23, 1896. Serial No. 596,611.
- 582,540. IGNITER FOR EXPLOSIVE-ENGINES. Oscar Mueller, Decatur, Ill. Filed July 22, 1896. Serial No. 600,168.
- 582,546. APPARATUS FOR GENERATING ACETYLENE GAS. Jerome J. Patterson, Batavia, N. Y., assignor of three-fourths to Isaac R. Barton, same place, John William Speaight, Brooklyn, and Walter C. Nichols, Buffalo, N. Y. Filed Dec. 22, 1896. Serial No. 616,581.
- 582,548. PROCESS OF GENERATING ACETYLENE GAS. Charles E. Rand, Chicago, Ill. Filed July 29, 1896. Serial No. 597,442.
- 582,560. GAS-RETORT LID. Thomas B. Tinney, Philadelphia, Pa., assignor of one-half to William McDonald, same place. Filed June 5, 1896. Serial No. 594,426.
- 582,573. DEVICE FOR REGULATING GAS AND AIR MIXTURES IN BUNSEN BURNERS. Hans Axmann, Erfurt, Germany. Filed July 7, 1896. Serial No. 598,353.
- 582,575. FLEXIBLE PIPE-JOINT. James C. Bayles, East Orange, N. J., assignor to Lewis C. Bayles, Branford, Conn. Filed Dec. 9, 1896. Serial No. 614,980.

May 18.

- 582,619. AUTOMATIC GAS-LIGHTING DEVICE. Jean W. Canellopoulos and Henri O. Kratz-Boussac, Paris, France. Filed Sept. 29, 1896. Serial No. 607,340. Patented in Germany, Mar. 21, 1896; in Hungary, Apr. 13, 1896, No. 6,102; in Norway Apr. 15, 1896, No. 5,024; in Switzerland Apr. 15, 1896, No. 12,118; in Luxemburg Apr. 19, 1896, No. 2,491; in Austria May 2, 1896, No. 46/1,745; in Italy June 30, 1896, XXXI, 41,356, LXXXI, 156, and in Spain July 28, 1896, No. 18,925.
- 582,620. GAS-ENGINE. James A. Charter, Beloit, Wis. Filed Apr. 11, 1895. Serial No. 545,374.
- 582,626. GAS-BURNER. Charles H. English, Washington, D. C. Filed June 25, 1896. Serial No. 596,917.
- 582,655. APPARATUS FOR MANUFACTURING GAS. Ferdinand Logan, Phoenixville, Pa. Filed May 8, 1896. Serial No. 590,687.
- 582,781. COIN-FREED GAS-METER. Harry Gamwell and Charles Gamwell, Liverpool, England, assignors of one-half to James Lind and John Lind, same place. Filed Sept. 26, 1896. Serial No. 607,043.
- 582,875. AUTOMATIC GAS-LIGHTING APPARATUS FOR INCANDESCENT GAS-LIGHTS. Albert Rammoser, Berlin, Germany, assignor to George Loewenberg, same place. Filed Nov. 2, 1896. Serial No. 610,877.
- 582,985. BURNER AND APPLIANCE FOR SUPPORTING INCANDESCENT GAS-MANTLES. Joseph De Brouwer, Bruges, Belgium. Filed Dec. 31, 1895. Serial No. 573,968. Patented in Belgium Nov. 18, 1895, No. 118,476.

May 25.

- 583,092. WELSBACH OR OTHER MANTLE OR INCANDESCENT. Waldron Shapleigh, Philadelphia, Pa., assignor to the Welsbach Light Company, Gloucester, City, N. J. Filed Mar. 24, 1897. Serial No. 628,960.
- 583,187. INCANDESCENT GAS-BURNER. Joseph B. de Léry, New York, N. Y. Filed Apr. 3, 1897. Serial No. 630,536.
- 583,225. GAS-BURNER. John Friedlander, St. Louis, Mo. Filed Jan. 29, 1897. Serial No. 621,229.
- 583,252. DEVICE FOR STOPPING LEAKY JOINTS IN GAS OR OTHER PIPES. Solomon R. Dresser, Bradford, Pa. Filed June 20, 1894. Serial No. 515,154.
- 583,262. PROCESS OF AND APPARATUS FOR DISTILLING AMMONIA. Henrik J. Krebs, Wilmington, Del. Filed June 4, 1891. Serial No. 395,113.
- 583,286. ACETYLENE-GAS BURNER. Philipp Von Frays and Heinrich Bosch, Nuremberg, Germany, assignors to The Firm of I. Von Schwarz, same place. Filed Aug. 12, 1895. Serial No. 559,091.
- 583,300. GAS-VALVE. Edward N. Dickerson, New York, N. Y. Filed Aug. 3, 1896. Serial No. 601,550.

- 583,303. ELECTRIC GAS-LIGHTING ATTACHMENT. William H. Fargo, San Francisco, Cal. Filed Aug. 6, 1896. Serial No. 601,863.
- 583,344. INCANDESCENT GAS-LAMP. William Tice, New York, N. Y. Filed Jan. 15, 1897. Serial No. 619,396.
- 583,399. GAS OR VAPOR ENGINE. George W. Lewis, Chicago, Ill. Filed July 15, 1895. Serial No. 555,974.

June 1.

- 583,495. GAS-ENGINE. Harry B. Maxwell, Rome, N. Y. Filed July 13, 1896. Serial No. 598,926.
- 583,507. GAS-ENGINE. John W. Raymond, Racine, Wis. Filed Jan. 13, 1896. Serial No. 575,303.
- 583,508. GAS-ENGINE. John W. Raymond, Racine, Wis. Filed Jan. 13, 1896. Serial No. 575,304.
- 583,511. GAS-BURNER. Wm. W. Seeley, Brooklyn, N. Y. Filed Feb. 3, 1897. Serial No. 621,814.
- 583,579. DEVICE FOR POURING PIPE-JOINTS. Marvin E. Otis, Rochester, N. Y. Filed Nov. 14, 1896. Serial No. 612,102.
- 583,584. GAS-ENGINE. George Westinghouse and Edwin Ruud, Pittsburg, Pa. Filed April 22, 1896. Renewed Apr. 29, 1897. Serial No. 634,463.
- 583,585. MEANS FOR CONTROLLING AND REGULATING OPERATION OF GAS-ENGINES. George Westinghouse, Jr., and Edwin Ruud, Pittsburg, Pa. Filed Dec. 7, 1895. Serial No. 571,386.
- 583,586. ELECTRIC IGNITER FOR GAS-ENGINES. George Westinghouse and Edwin Ruud, Pittsburg, Pa. Filed Sept. 22, 1896. Serial No. 606,624.
- 583,600. MEANS FOR OBVIATING SMELL OF INTERNAL-COMBUSTION ENGINES. Gustav Langen, Philadelphia, Pa. Filed Jan. 14, 1896. Serial No. 575,516.
- 583,627. GAS-ENGINE. Lewis H. Nash, South Norwalk, Conn., assignor to the National Meter Co., New York, N. Y. Filed May 22, 1890. Serial No. 352,736.
- 583,628. GAS OR OIL ENGINE. Lewis H. Nash, South Norwalk, Conn., assignor to the National Meter Co., New York, N. Y. Filed Jan. 14, 1896. Serial No. 575,459.
- 583,630. ELECTRIC GAS-LIGHTER. John Y. Parke, Philadelphia, Pa. Filed Jan 2, 1897. Serial No. 617,724.
- 583,665. GAS-RETORT. James E. Weaver, Pittsburg, Pa. Filed May 28, 1894. Serial No. 512,598.
- 583,666. GAS-DISTRIBUTING SYSTEM. James E. Weaver, Pittsburg, Pa. Filed May 28, 1894. Serial No. 512,599.
- 583,671. APPARATUS FOR MAKING WATER-GAS. Charles R. Collins, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place. Filed Jan. 8, 1895. Serial No. 534,173.

- 583,697. GAS-MAKING APPARATUS. James E. Weaver, Pittsburg, Pa. Filed Aug. 10, 1893. Serial No. 482,822.
- 583,761. ACETYLENE-GAS GENERATOR. Frank A. Mitchell, Wilmington, Del. Filed Feb. 12, 1897. Serial No. 623,177.
- 583,872. GAS-ENGINE. John H. Tuffs, Syracuse, N. Y. Filed Sept. 9, 1895. Serial No. 561,893.

June 8.

- 583,915. APPARATUS FOR GENERATING GAS. Burdett Loomis, Hartford, Conn. Filed Apr. 9, 1894. Serial No. 506,904.
- 583,982. GASOLINE AND GAS ENGINE. William F. Davis, Waterloo, Iowa, assignor to the Davis Gasoline Engine Company, same place. Filed May 31, 1895. Serial No. 551,325.
- 584,056. IGNITING DEVICE. Bogulan Jolles, Vienna, Austria-Hungary. Filed Feb. 1, 1897. Serial No. 621,537.
- 584,097. HYDROCARBON-MOTOR. Martin H. Rumpf, Brussels, Belgium. Filed Sept. 9, 1896. Serial No. 605,221.
- 584,130. GAS-ENGINE. Frederick C. Griswold, Port Jarvis, N. Y., assignor of one-half to Martin L. Chambers, same place. Filed Nov. 25, 1896. Serial No. 613,367.
- 584,188. GAS OR VAPOR ENGINE. Presley B. McLelland and Stephen D. McLelland, Chicago, Ill. Filed Dec. 20, 1895. Serial No. 572,816.
- 584,282. GAS-ENGINE. Franz Bürger and Henry M. Williams, Fort Wayne, Ind. Filed Aug. 1, 1894. Serial No. 519,205.

June 15.

- 584,326. APPARATUS FOR HEATING WATER. William C. Clarke, New York, N. Y., assignor to the Gilbert & Barker Manufacturing Company, of Massachusetts. Filed Jan. 15, 1895. Serial No. 534,991.
- 584,339. APPARATUS FOR MANUFACTURING ACETYLENE GAS. John H. Exley, Bradford, England. Filed Dec. 13, 1895. Serial No. 572,048.
- 584,349. PROCESS OF CARBURETING GAS. Arthur B. Griffen, Verona, N. J., assignor to the Gilbert and Barker Manufacturing Company, Springfield, Mass. Filed Jan. 22, 1895. Serial No. 535,770.
- 584,448. GAS-ENGINE. Cornelius C. Wright and William J. Stevens, Titusville, Pa.; said Wright assignor to said Stephens. Filed Sept. 8, 1896. Serial No. 605,144.
- 584,472. GAS APPARATUS. Henry A. Jones, New York, N. Y. Filed Nov. 16, 1894. Renewed Nov. 18, 1896. Serial No. 612,649.
- 584,475. GAS-SAVING CHECK. Adolph Kuhne, New York, N. Y. Filed Dec. 8, 1896. Serial No. 614,968.

- 584,513. APPARATUS FOR PRODUCING GAS. Maurice Lorois, Nantes, France. Filed Sept. 4, 1894. Serial No. 522,006. Patented in France July 30, 1892, No. 223,360; in India Sept. 9, 1892, No. 2,579; in England Sept. 13, 1892, No. 16,413; in Belgium Sept. 26, 1892, No. 101,511; in Switzerland Sept. 26, 1892, No. 5,877; in Luxemburg, Sept. 27, 1892, No. 1,696; in Italy Sept. 27, 1892, XXVII, 32,757; in Cape Colony Oct. 11, 1892, No. 268; in Norway Oct. 11, 1892, No. 3,055; in Victoria Oct. 21, 1892, No. 10,073; in New South Wales Oct. 24, 1892, No. 4,066; in Spain Nov. 24, 1892, No. 13,850, and in Canada Dec. 19, 1893, No. 44,918.
- 584,527. GAS-BURNER. Victor H. Slinack, Philadelphia, Pa., assignor to the Pennsylvania Globe Gas Light Co. of Pennsylvania. Filed Feb. 1, 1897. Serial No. 621,409.
- 584,605. GAS-MACHINE. Henry C. Sergeant, Westfield, N. J. Filed Aug. 22, 1893. Serial No. 483,752.
- 584,622. GAS-ENGINE. John O. Brown, Dayton, Ohio, assignor to Allie M. Brown, same place. Filed Oct. 24, 1895. Serial No. 566,688.
- 584,674. GAS-ENGINE. Edward B. Dake, Muskegon, Mich. Filed Apr. 17, 1896. Serial No. 588,026.
- 584,713. APPARATUS FOR MANUFACTURING GAS. John L. Stewart, San Francisco, Cal. Filed Apr. 19, 1890. Serial No. 348,644.
- 584,714. APPARATUS FOR MANUFACTURING GAS. John L. Stewart, Philadelphia, Pa. Filed Dec. 23, 1890. Serial No. 375,598.

June 22.

- 584,772. APPARATUS FOR BURNING ACETYLENE GAS. Edward N. Dickerson and Julius J. Suckert, New York, N. Y. Filed Jan. 23, 1897. Serial No. 620,340.
- 584,785. ELECTRIC GAS LIGHTING AND EXTINGUISHING APPARATUS. Gottfried F. Krieger, Kiel, Germany, assignor to the Universal Gasz nder-Gesellschaft, mit Beschr nkter Haftung, Hamburg, Germany. Filed Mar. 2, 1897. Serial No. 625,709.
- 584,920. COOLING DEVICE FOR GAS OR PETROLEUM MOTORS. Emil Capitaine, Frankfort-on-the-Main, Germany, assignor to George T. Harris, Philadelphia, Pa. Filed Nov. 7, 1896. Serial No. 611,328.
- 584,931. ACETYLENE-GAS GENERATOR. Henry F. Fuller, Chicago, Ill., assignor to the Walmsley, Fuller & Company, same place. Filed Dec. 28, 1896. Serial No. 617,269.
- 584,946. ACETYLENE-GAS APPARATUS. Royer Luckenbach, Philadelphia, Pa., assignor, by mesne assignments, to Cornelius E. Baird, same place. Filed Dec. 23, 1896. Serial No. 616,795.
- 584,960. EXPLOSIVE-ENGINE. Charles Quast, Marion, Ohio. Filed Sept. 5, 1894. Serial No. 522,179.
- 584,961. GAS-ENGINE. Charles Quast, Marion, Ohio. Filed Nov. 6, 1894. Serial No. 528,115.

585,115. GAS-ENGINE. Charles A. Miller, Springfield, Ohio, assignor to the Miller Gas Engine Company, same place. Filed Jan. 6, 1896. Serial No. 574,491.

585,127. EXPLOSIVE GAS-ENGINE. George W. Starr and John H. Cogswell, Havana, Ill. Filed Aug. 26, 1896. Serial No. 603,991.

June 29.

585,230. GAS-TURBINE. James G. Sanderson, Scranton, Pa. Filed Mar. 6, 1896. Serial No. 582,079.

585,339. FLUID-PRESSURE ENGINE. Walter H. Knight, New Brighton, N. Y. Filed Dec. 28, 1895. Serial No. 573,575.

585,434. EXPLOSIVE-ENGINE. William E. Gibbon, Colchester, England. Filed Oct. 24, 1896. Serial No. 609,946.

585,504. GAS-ENGINE. Lewis S. Brown, Columbus, Ohio. Filed Oct. 22, 1896. Serial No. 609,686.

585,601. GAS-ENGINE. Herbert B. Steele, Malden, Mass. Filed Dec. 10, 1895. Serial No. 571,628.

585,625. ACETYLENE-GAS GENERATOR. James H. Dougherty, Philadelphia, Pa. Filed Jan. 27, 1896. Serial No. 576,940.

585,631. GAS-BROILER. Frank A. Langwith, New York, N. Y., assignor, by direct and mesne assignments, to Joseph J. Meyers, same place. Filed Nov. 11, 1896. Serial No. 611,716.

July 6.

585,651. GAS-ENGINE. Franz Bürger, Fort Wayne, Ind., assignor of three-fourths to Henry M. Williams, same place. Filed Mar. 26, 1894. Serial No. 505,205.

585,652. GAS-ENGINE. James A. Charter, Beloit, Wis. Filed Sept. 26, 1896. Serial No. 607,087.

585,831. GAS-EXHAUSTING APPARATUS. Johan W. Th. Olan, New York, N. Y. Original application filed Mar. 13, 1893. Serial No. 465,761. Divided and this application filed June 5, 1897. Serial No. 639,573.

585,902. SELF-CLOSING GAS-BURNER. Frank P. Barney, Chartley, Mass. Filed Feb. 25, 1897. Serial No. 625,011.

585,919. INCANDESCENT GAS-BURNER. Jean Baptiste Paul Wanauld de Malberg, Rheims, France. Filed July 25, 1896. Serial No. 600,493. Patented in France Jan. 29, 1896, No. 253,433; in Belgium Mar. 14, 1896, No. 120,354, Apr. 17, 1896, No. 120,920, Apr. 28, 1896, No. 120,093, and May 1, 1896, No. 121,141; and in England Mar. 25, 1896, No. 6,581, and May 1, 1896, No. 11,100.

585,932. HEATING APPARATUS FOR GAS-BURNERS. Theodore Gühring, New York, N. Y. Filed Jan. 30, 1897. Serial No. 621,332.

- 585,952. STARTING MECHANISM FOR GAS-ENGINES. Simeon Colley, Sr., and Simeon Colley, Jr., Springfield, Ohio. Filed Feb. 27, 1897. Serial No. 625,263.
- 586,085. GAS-BURNER. Leonard Henkle, Rochester, N. Y., assignor, by mesne assignments, to the Consolidated Sterling Incandescent Gas Lamp Company, of New Jersey. Filed May 5, 1896. Serial No. 590,288.
- 586,086. GAS-METER CASING. William H. Hopper, Philadelphia, Pa., and Stephen Milsted, Hammonton, N. J. Filed Sept. 28, 1896. Serial No. 607,222.
- 586,089. AUTOMATIC GAS-PRESSURE REGULATOR. Alfred Hall, Chicago, Ill. Filed Feb. 12, 1897. Serial No. 623,126.

July 13.

- 586,175. GAS-BURNER. Richard Gäbel, Dresden, Germany. Filed Jan. 27, 1896. Serial No. 577,219.
- 586,182. GAS-BURNER TIP. Isaac Harrison and Albert M. Kilberg, Scranton, Pa., said Kilberg assignor of one-twelfth to Aaron Goldberg, Joseph Burros, and Isidor Finkelstein, same place. Filed Apr. 11, 1896. Serial No. 587,085.
- 586,194. ACETYLENE-GAS GENERATOR. Charles Matthews, Jr., Chicago, Ill. Filed Mar. 29, 1897. Serial No. 629,835.
- 586,312. GAS-ENGINE. Charles Jacobson, Brooklyn, N. Y., assignor to the Climax Gas Engine Company, same place. Filed Sept. 24, 1895. Serial No. 563,569.
- 586,321. GAS-ENGINE. John D. Russ, Rahway, N. J., assignor, by direct and mesne assignments, to Maxwell Wyeth & Co., Brooklyn, N. Y. Filed Jan. 29, 1896. Serial No. 577,224.
- 586,409. GAS OR VAPOR ENGINE. Eugene P. Woillard, Sugden, Fla. Filed Apr. 15, 1896. Serial No. 587,625.
- 586,466. GAS-RETORT BENCH. James Twamley, Grand Forks, N. D. Filed Nov. 11, 1896. Serial No. 611,708.
- 586,479. ELECTRIC IGNITER FOR GAS-ENGINES. Harry S. Dosh, Baltimore, Md., assignor to George F. Obrecht and George Scheihing, same place. Filed Feb. 17, 1897. Serial No. 623,781.
- 586,499. AUTOMATIC CUT-OFF FOR GAS-BURNERS. Daniel W. Ketcham, U. S. Army. Filed Feb. 12, 1897. Serial No. 623,157.
- 586,511. IGNITER FOR EXPLOSIVE-ENGINES. Edward J. Pennington, Racine, Wis., assignor to Thomas Kane, trustee, Chicago, Ill. Filed May 13, 1895. Serial No. 549,039.
- 586,537. ELECTRIC GAS-LIGHTER. Frank Rhind, Bridgeport, Conn., assignor to The Bridgeport Brass Company, same place. Filed May 17, 1897. Serial No. 636,993.

July 20.

- 586,748. GAS-BURNER. Joseph Stubbers, Covington, Ky. Filed Feb. 21, 1896. Serial No. 580,150.
- 586,813. ELECTRICAL GAS-ALARM. John Erikson, Providence, R. I. Filed Apr. 3, 1897. Serial No. 630,540.
- 586,826. EXPLOSIVE-ENGINE. Frederick A. Redmon, San Francisco, Cal., assignor to Bainbridge L. Ryder, same place. Filed Oct. 9, 1896. Serial No. 608,345.
- 586,841. SWING-JOINT FOR GAS-FIXTURES. Henry P. Drew, New York, N. Y. Filed Feb. 27, 1897. Serial No. 625,268.
- 586,923. APPARATUS FOR MANUFACTURING GAS. Albert E. Aldrich, Lexington, Ky., assignor of one-tenth to Frank M. Flenner, same place. Filed June 24, 1896. Serial No. 596,744.

July 27.

- 586,968. FEED-WATER HEATER FOR GAS-MAKING APPARATUS. Arthur G. Glasgow, London, England, assignor to himself and Alexander C. Humphreys, New York, N. Y. Filed Oct. 16, 1896. Serial No. 609,052.
- 586,970. METHOD OF AND APPARATUS FOR MANUFACTURING CARBURETED WATER-GAS. Alexander C. Humphreys, Philadelphia, Pa., and Arthur G. Glasgow, New York, N. Y. Filed Feb. 18, 1895. Serial No. 538,791. Patented in England Feb. 12, 1895. No. 3,089.
- 586,988. PROCESS OF AND APPARATUS FOR MAKING GAS. William F. Browne, New York, N. Y. Filed Apr. 30, 1896. Serial No. 589,770.
- 586,994. MANUFACTURE OF MANTLES FOR INCANDESCENT GAS-LAMPS. John F. Duke, London, England. Filed Jan. 13, 1897. Serial No. 619,049.
- 587,026. PROCESS OF MANUFACTURING FILAMENTS AND MANTLES FOR INCANDESCENT GAS-LIGHTING. William L. Voelker, Elizabeth, N. J., assignor to The Voelker Light Co., of New Jersey. Filed Nov. 25, 1896. Serial No. 613,449.
- 587,102. MEANS FOR CLOSING GAS MAINS. Richard B. Meany, Union, Hudson Co., N. J. Filed Jan. 23, 1897. Serial No. 620,406.
- 587,109. GAS-FIXTURE. Ernest Stenstrom and Otto W. Stenstrom, Boston, Mass. Filed June 5, 1897. Serial No. 639,495.
- 587,138. PROCESS OF AND APPARATUS FOR MANUFACTURING METALLIC CARBIDES. Isaiah L. Roberts, Niagara Falls, N. Y. Filed Dec. 29, 1896. Serial No. 617,305.
- 587,203. APPARATUS FOR COMPELLING FLOW OF GAS BY MEANS OF CURRENTS OF LIQUIDS. Joseph Heaton, Brunswick, Me., assignor of one-half to Eugene Thomas, Topsham, Me. Filed Nov. 11, 1896. Serial No. 611,724.

August 3.

- 587,313. GAS STOVE. Jonathan Johnson, Lowell, Mass. Filed Jan. 31, 1895. Serial No. 536,799.
- 587,334. GAS BURNER. George E. Sharpe, Steubenville, Ohio. Filed Jan. 21, 1897. Serial No. 620,050.
- 587,428. GAS OR VAPOR COCK. Orlando F. Conihe, Boston, Mass. Filed Feb. 20, 1897. Serial No. 624,486.
- 587,509. PROCESS OF AND APPARATUS FOR MAKING METALLIC CARBIDES. Isaiah L. Roberts, Brooklyn, N. Y. Filed June 20, 1896. Serial No. 596,263.
- 587,533. ACETYLENE-GAS-GENERATING APPARATUS. John J. McGrane, Long Island City, N. Y. Filed Aug. 29, 1896. Serial No. 604,262.
- 587,583. GAS STOVE. Jonathan Johnson, Lowell, Mass. Filed Dec. 19, 1896. Serial No. 616,236.
- 587,627. GAS ENGINE. Adolph A. Williams, Duluth, Minn. Filed Apr. 18, 1896. Serial No. 588,112.

August 10.

- 587,747. IGNITER FOR EXPLOSIVE ENGINES. Philip Mueller, Decatur, Ill. Filed Dec. 18, 1896. Serial No. 616,133.
- 587,914. APPARATUS FOR PRODUCING ACETYLENE GAS. Charles F. J. B. Becherel, Paris, France, assignor to the Compagnie du Gaz Nouveau, same place. Filed Oct. 31, 1896. Serial No. 610,674.
- 588,061. GAS ENGINE. Henry C. Hart, Detroit, Mich., assignor to the Henry C. Hart Manufacturing Co., same place. Filed May 17, 1894. Serial No. 511,532.
- 588,062. GAS ENGINE. Henry C. Hart, Detroit, Mich., assignor to the Henry C. Hart Manufacturing Co., same place. Filed Dec. 28, 1896. Serial No. 617,295.
- 588,077. GAS INCANDESCENT. Robert Moscheles, Berlin, Germany, assignor to Louis H. Hall, Philadelphia, Pa. Original application filed July 3, 1896. Serial No. 598,002. Divided and this application filed Nov. 17, 1896. Serial No. 612,496.

August 17.

- 588,154. GAS APPARATUS. Julius Leede, Minneapolis, Minn. Filed Sept. 27, 1895. Renewed Jan. 22, 1897. Serial No. 620,285.
- 588,227. REGULATING CONTRIVANCE FOR GAS HEATING BURNERS. Heinrich Kikow, Berlin, Germany. Filed Aug. 15, 1896. Serial No. 602,915.
- 588,230. PROCESS OF GENERATING GAS FROM CARBIDS. Elmer F. Mackusick, New York, N. Y., assignor to the Electro Gas Company, of West Virginia. Filed June 17, 1897. Serial No. 641,181.

- 588,379. STREET GAS LAMP. Charles R. Bellamy, Liverpool, England. Filed Jan. 7, 1897. Serial No. 618,288.
- 588,535. ACETYLENE GAS GENERATOR. Flavel Simonson, Sterling, Ill. Filed Feb. 11, 1897. Serial No. 622,998.

August 24.

- 588,593. APPARATUS FOR GENERATING ACETYLENE GAS. David C. Morency, Levis, Canada. Filed Mar. 29, 1897. Serial No. 629,714. Patented in Canada Feb. 10, 1897. No. 54,942.
- 588,632. GAS METER. Roswell H. Buckingham, Evanston, Ill., assignor to C. H. Evans, trustee, Chicago, Ill. Filed Sept. 17, 1896. Serial No. 606,125.
- 588,876. GAS ENGINE. Charles Quast, Marion, Ohio. Filed Sept. 5, 1894. Serial No. 522,180.
- 588,917. IGNITER FOR GAS ENGINES. Charles White and Arthur R. Middleton, Baltimore, Md. Filed Apr. 11, 1895. Serial No. 545,286.

August 31.

- 589,108. MOTOR WORKED BY HYDROCARBON OR OTHER GASES. Christopher T. Wordsworth, Manchester, Edmund Wiseman, Luton, and John Holroyd, London, England. Filed Nov. 23, 1896. Serial No. 613,176.
- 589,150. GAS ENGINE. John C. Wilson, Allegheny, Pa. Filed Sept. 11, 1896. Serial No. 605,545.
- 589,219. GAS APPARATUS. John W. Ogden, Plainfield, N. J. Filed Apr. 23, 1897. Serial No. 633,436.
- 589,322. CHIMNEY FOR INCANDESCENT GAS BURNERS. Ernest M. White, Philadelphia, Pa. Filed Jan. 13, 1897. Serial No. 619,086.
- 589,323. CHIMNEY FOR INCANDESCENT GAS BURNERS. Ernest M. White, Philadelphia, Pa., assignor to Thomas White, same place. Filed Dec. 2, 1895. Serial No. 570,785.
- 589,335. GAS ENGINE GOVERNOR. Robert Caldwell, Auckland, New Zealand. Filed Oct. 30, 1896. Serial No. 610,566.
- 589,342. TIP FOR ACETYLENE GAS BURNERS. Edward J. Dolan, Philadelphia, Pa., assignor, by mesne assignments, to the Acetylene House Lighting Company, of West Virginia. Filed Feb. 18, 1897. Serial No. 624,039.
- 589,343. INCANDESCENT BURNER. John H. Dubrow, Cleveland, Ohio, assignor to Willis U. Masters, same place. Filed Mar. 27, 1896. Serial No. 585,049.

- 589,376. MANUFACTURE OF MANTLES FOR INCANDESCENT GAS LIGHTS. Konrad Trobach, Pankow, Germany, assignor to Max Arendt, Berlin, Germany. Filed Jan. 30, 1895. Renewed July 15, 1897. Serial No. 644,728. (No specimens.) Patented in England Jan. 12, 1895, No. 811; in Switzerland Mar. 22, 1895, No. 10,287, and in Germany Sept. 26, 1896, No. 88,437.
- 589,393. GAS INCANDESCENT. Robert Moscheles, Berlin, Germany, assignor to Louis H. Hall, Philadelphia, Pa. Filed Sept. 22, 1896. Serial No. 606,654.

September 7.

- 589,404. ACETYLENE GAS LAMP. Gianni Bettini, New York, N. Y. Filed Dec. 19, 1895. Serial No. 572,620.
- 589,486. RANGE GAS GENERATOR. Miguel Vélez, New York, N. Y. Filed Nov. 16, 1894. Serial No. 528,977.
- 589,509. ELECTRICAL IGNITER FOR GAS ENGINES. Edward R. Moffitt, San Francisco, Cal. Filed Feb. 27, 1896. Serial No. 581,062.
- 589,583. GOVERNOR FOR GAS ENGINES. Fred. W. Spacke, Indianapolis, Ind. Filed April 7, 1896. Serial No. 586,570.
- 589,713. PROCESS OF AND APPARATUS FOR GENERATING ACETYLENE GAS. John C. Gallagher, Elmira, N. Y., assignor of two-thirds to David W. Payne and M. C. Arnot, same place. Filed Mar. 10, 1896. Serial No. 582,574.
- 589,745. DEVICE FOR INDICATING ESCAPE OF GAS. Michael O'Donovan, Boston, Mass., assignor of one-half to Charles W. Buxton, Waverly, Mass. Filed May 24, 1895. Renewed Jan. 25, 1897. Serial No. 620,682.
- 589,799. ACETYLENE GAS GENERATOR. George Taylor, Dallas, Tex. Filed Apr. 5, 1897. Serial No. 630,671.

September 14.

- 589,972. OVEN FOR VAPOR OR GAS STOVES. Ludwig Lentz, Covington, Ky. Filed Feb. 21, 1896. Serial No. 580,178.
- 589,991. ACETYLENE GAS GENERATOR. Nelson Likins, Minneapolis, Minn., assignor of two-fifths to F. R. Salisbury and W. E. Satterlee, same place. Filed Oct. 3, 1896. Serial No. 607,762.
- 590,003. AUTOMATIC CUT-OFF GAS BURNER. Fred. F. Cushman, Boston, Mass. Filed July 6, 1897. Serial No. 643,525.
- 590,080. EXPLOSIVE GAS ENGINE. James S. Walch, Providence, R. I. Filed Jan. 23, 1897. Serial No. 620,371.

September 21.

- 590,223. ACETYLENE GAS BURNER. Leonard Henkle, Rochester, N. Y., assignor to Henry E. Shaffer, same place. Filed July 2, 1897. Serial No. 643,230.
- 590,359. BURNER FOR INCANDESCENT GAS LIGHTING. William R. Clay, Farnworth, England. Filed May 27, 1896. Serial No. 593,267.
- 590,360. ATTACHMENT FOR INCANDESCENT GAS BURNERS. William R. Clay and Ben Walmsley, Bolton, England. Filed Jan. 23, 1897. Serial No. 620,380.
- 590,419. WELSBACH GAS BURNER. John Lines, Waterbury, Conn., assignor to The Scovill Manufacturing Company, same place. Filed May 27, 1896. Serial No. 593,249.
- 590,441. ACETYLENE GAS GENERATOR. Delbert J. Reynolds, Winnebago, Minn., assignor, by mesne assignments, to the Walmsley, Fuller & Company, Chicago, Ill. Filed July 17, 1896. Serial No. 599,517.
- 590,526. GAS BURNER FOR LIGHTING. Vincent Jarre and Elie J. Usaunaz, Paris, France. Filed March 3, 1897. Serial No. 625,861.

September 28.

- 590,586. INCANDESCENT GAS LAMP FOR STREET USE. Antoine C. Niermeyer, Deventer, Netherlands, assignor to Ernest Edwin Probert, New Barnet, England. Filed June 29, 1897. Serial No. 642,783.
- 590,592. APPARATUS FOR GENERATING ACETYLENE GAS. Howard L. Pyle, Louis Lichtenstein, and John C. Brison, Wilmington, Del. Filed Jan. 26, 1897. Serial No. 620,758.
- 590,674. APPARATUS FOR GENERATING ACETYLENE GAS. Axel A. Strom, Austin, Ill., assignor to The Walmsley & Company, Chicago, Ill. Filed June 14, 1897. Serial No. 640,735.
- 590,693. INCANDESCENT GAS BURNER. Joseph Warry, Birmingham, England. Filed Dec. 5, 1896. Serial No. 614,549. Patented in England Jan. 29, 1896. No. 2,075.
- 590,796. GAS ENGINE. Arnold J. Tackle, Oakland, Cal. Filed Apr. 15, 1897. Serial No. 632,286.
- 590,864. REGENERATIVE GAS FURNACE. Frederick Siemens, Dresden, Germany. Filed Feb. 26, 1897. Serial No. 625,228.
- 590,865. METHOD OF MOUNTING INCANDESCENT MANTLES ON GAS BURNERS. Wilhelm H. A. Sieverts, Hamburg, Germany. Filed Oct. 17, 1896. Serial No. 609,234.
- 590,892. AUTOMATIC REGULATING DEVICE FOR GAS BURNERS. Charles W. Knight, New York, N. Y. Filed Oct. 26, 1896. Serial No. 610,113.
- 590,893. METHOD OF AND APPARATUS FOR MANUFACTURING GAS. John H. Ladd, London, England. Filed July 13, 1895. Serial No. 555,866. Patented in England May 27, 1895. No. 10 477.
- 590,941. LAMP FOR GENERATING AND BURNING ACETYLENE GAS. Charles W. Beck, Chicago, Ill. Filed July 27, 1896. Serial No. 600,613.

UNITED STATES PATENTS RELATING TO GAS.

EXPIRED OCTOBER 1ST, 1896 TO OCTOBER 1ST, 1897.

October 7, 1896.

- 220,284. GAS EXHAUSTER GOVERNORS. William Helme, Philadelphia, Pa. Filed Aug. 30, 1879.
- 220,452. VAPOR BURNERS. Henry Wellington, Greenpoint, N. Y. Filed Mar. 3, 1879.

October 14.

- 220,470. APPARATUS FOR VAPORIZING AND BURNING HYDROCARBON OILS. John A. Frey, New York, N. Y. Filed Feb. 13, 1879.
- 220,490. ATMOSPHERIC GAS BURNER. Albanus W. Morton, Brooklyn, N. Y., assignor of one-half his right to George A. Bush, Rahway, N. J. Filed June 24, 1879.
- 220,504. GLOBE HOLDERS FOR GAS FIXTURES. Henry B. Stillman, New York, N. Y. Filed March 1, 1879.
- 220,554. GAS GENERATOR AND BURNER. Alfred E. Watkins, Baltimore, Md., assignor of three-eighths of his right to Samuel H. Adams, and one-eighth of his right to John S. Williams, all of same place. Filed Feb. 3, 1879.
- 220,577. GAS REGULATING BURNERS. John W. Cloud, Altoona, Pa. Filed Aug. 8, 1879.
- 220,665. VAPOR BURNERS. William H. Russell, Sedalia, Mo. Filed Sept. 15, 1879.

October 21.

- 220,704. ELECTRIC GAS LIGHTING DEVICE. William C. Cutler, Chelsea, Mass. Filed July 5, 1878.
- 220,736. GAS BURNERS. Oakes Tirrill, Brooklyn, N. Y. Filed July 19, 1879.
- 220,838. GAS STOVES. Charles Hoffman, New York, N. Y. Filed Sept. 4, 1879.

October 28.

- 220,929. VAPOR BURNERS. Frederick Marquart, Cleveland, Ohio. Filed Sept. 6, 1879.
- 221,125. FLEXIBLE GAS TUBING. James Taylor, Providence, R. I., assignor to Eugene F. Phillips, same place. Filed Dec. 23, 1878.

November 4.

- 221,169. GAS HEATING AND COOKING FURNACES. Henry Q. Hawley, Albany, N. Y. Filed June 27, 1879.
- 221,205. VAPOR STOVES. Florian Zugg, Peoria, Ill. Filed Oct. 8, 1879.
- 221,257. PROCESS AND APPARATUS FOR UTILIZING IN FURNACES THE GASES FROM COKING COAL. Levi Stevens, Washington, D. C. Filed Apr. 4, 1879.

November 11.

- 221,565. APPARATUS FOR THE MANUFACTURE OF COAL GAS. Charles W. Isbell, New York, N. Y. Filed Apr. 21, 1879.
- 221,566. SCRUBBERS FOR THE MANUFACTURE OF GAS. Charles W. Isbell, New York, N. Y. Filed Aug. 5, 1879.

November 18.

- 221,688. GAS STOVES. William McDonald and Seth E. Parsons, Albany, N. Y., assignors to Donald McDonald and Noel E. Sisson, same place. Filed Sept. 26, 1879.
- 221,758. LIGHTING DEVICE. Christian Westphal, Frankfort-on-the-Main, Germany. Filed July 16, 1879.

November 25.

- 221,937. VAPOR BURNER. Edward F. Rogers, Boston, Mass. Filed July 14, 1879.
- 221,941. HEATING BENCHES OF GAS FIXING RETORTS. Thomas F. Rowland, New York, N. Y. Filed Oct. 11, 1879.
- 221,942. VAPOR GAS APPARATUS. James Savage, Canarsie, N. Y. Filed Mar. 24, 1879.
- 221,948. CARBURETERS. James Wayland, Newark, N. J., assignor to Edward F. Bray, Elizabeth, N. J., Albion L. Mellen, Boston, Mass., and David Currier, New York, N. Y., one-fourth to each. Filed Mar. 15, 1879.
- 221,950. GAS GOVERNORS. George S. Woodruff, Grand Rapids, Mich. Filed July 15, 1879.

December 2.

- 222,156. HYDROCARBON BURNER. Richard S. Robertson, Pittsburg, Pa. Filed Dec. 11, 1878.
- 222,184. LIQUID GAS MOTORS. Antoine Gateau, Tournus, France. Filed Aug. 30, 1879. Patented in France April 30, 1879.
- 222,289. GAS PRESSURE GOVERNOR. Miles Lees, Providence, R. I. Filed Apr. 25, 1879.

December 9.

- 222,467. GAS MOTOR ENGINES. Gottlieb W. Darniler, Deutz-on-Rhine, Germany. Filed Oct. 27, 1879. Patented in England Aug. 12, 1879.
- 222,479. GAS BURNERS. Pompeo Moncalieri, Italy. Filed Nov. 3, 1879.
- 222,555. ELECTRIC GAS LIGHTING APPARATUS. William H. H. Whiting, Chelsea, Mass. Filed Sept. 5, 1879.
- 222,562. GAS RETORT CHARGERS. Abbott Q. Ross, Cincinnati, Ohio. Filed Sept. 29, 1879.
- 222,563. MACHINERY FOR DISCHARGING RETORTS. Abbott Q. Ross, Cincinnati, Ohio. Filed Sept. 8, 1879.
- 222,564. GAS RETORT DISCHARGING APPARATUS. Abbott Q. Ross, Cincinnati, Ohio. Filed July 31, 1879.
- 222,565. DISCHARGING APPARATUS FOR GAS RETORTS. Abbott Q. Ross, Cincinnati, Ohio. Filed July 1, 1879.

December 16.

- 222,569. GAS ENGINE. Franz Bürger, Washington, D. C. Filed May 5, 1879.
- 222,610. GAS STOVE. William A. Turner, Providence, R. I. Filed Oct. 8, 1879.
- 222,660. GAS ENGINE. Franz Bürger, Washington, D. C. Filed May 19, 1879.

December 23.

- 222,822. GAS CARBURETER. Charles A. Howard, Pontiac, Mich. Filed Sept. 17, 1879.

December 30.

- 223,051. VAPOR BURNER. Edward M. Lowden, New York, N. Y. Filed May 27, 1879.
- 223,064. GAS REGULATOR. James S. De Palos, Brooklyn, N. Y. Filed Dec. 6, 1879.
- 223,084. HYDROCARBON BURNER. Francis M. Wareham, Oil City, Pa., assignor to Benjamin F. Brundred, same place. Filed Dec. 4, 1878.

January 13, 1897.

- 223,490. CARBURETER. Henry C. DeWitt, Chicago, Ill. Filed Nov. 17, 1879.
- 223,555. DIFFERENTIAL GAS MOTOR. Cyprien M. Tessie du Motay, Paris, France, and Leonard F. Beckwith, New York, N. Y. Filed June 3, 1879.

- 223,570. GAS REGULATOR. Moses G. Wilder, Brooklyn, N. Y. Filed Oct. 22, 1879.
- 223,573. REGULATING GAS TAP. John C. Ainsworth, Bury, and Robert K. Roberts, Tottington, County of Lancaster, Great Britain. Filed Nov. 24, 1879.
- 223,578. ELECTRIC GAS LIGHTING DEVICE. Thimoleon Cailteau, New York, N. Y. Filed Nov. 18, 1879.
- 223,582. CARBURETER. Henry C. DeWitt, Chicago, Ill. Filed Nov. 29, 1879.

January 20.

- 223,763. CARBURETING APPARATUS. David P. Sanders, Canton, Pa., assignor to himself and Oliver P. Sanders. Filed Nov. 21, 1878.

January 27.

- 223,966. VAPOR BURNER. Jacob B. Wallace and Zebulon Davis, Canton, Ohio. Filed Sept. 22, 1879.

February 3.

- 224,056. GAS STOVE. William A. Turner, Providence, R. I., assignor to the Retort Gas Stove Company, of same place, Filed Sept. 26, 1879.
- 224,192. LIGHTING DEVICE. James J. Lawler, Scranton, Pa., assignor to himself and James M. Everhart, same place. Filed July 14, 1879.

February 10.

- 224,266. PROCESS AND APPARATUS FOR MANUFACTURING GAS FOR HEATING AND ILLUMINATING PURPOSES. Henry Y. Attrill and William Farmer, New York, N. Y., said Farmer assignor to said Attrill. Filed Sept. 26, 1879.
- 224,320. APPARATUS FOR THE MANUFACTURE OF GAS. Henry Y. Attrill and William Farmer, New York, N. Y., said Farmer assignor to said Attrill. Filed Nov. 26, 1879.
- 224,371. VAPOR BURNER. Curtis Woodhull, Buffalo, N. Y. Filed Sept. 23, 1879.

February 17.

- 224,539. EXTINGUISHER. William H. Hovey, Springfield, Mass. Filed July 14, 1879.
- 224,592. CARBURETING APPARATUS. Charles L. Heywood and Reinhold Boklen, Boston, Mass., assignors to the Carbureted Air Gas Company, same place. Filed June 11, 1879.

February 24.

- 224,766. VAPOR MOTOR. Edwin L. Brady, New York, N. Y. Filed Dec. 13, 1879.
- 224,776. AUTOMATIC GAS EXTINGUISHER. Thomas W. Hamilton, Springfield, Mass. Filed Dec. 15, 1879.
- 224,845. APPARATUS FOR THE MANUFACTURE OF WOOD AND OIL GAS. George Ramsdell, Oswego, N. Y. Filed Nov. 26, 1879,
- 224,865. APPARATUS FOR INDICATING THE ACTION OF WATER GAS RETORTS. Henry C. Bowen, New York, N. Y. Filed Nov. 18, 1879.
- 224,866. METHOD OF DETERMINING THE TEMPERATURE AND PROGRESS OF DISTILLATION IN GAS RETORTS. Henry C. Bowen, New York, N. Y. Filed Jan. 9, 1879.

March 2.

- 225,067. VAPOR BURNER. Fordyce A. Lyman, Cleveland, Ohio. Filed May 31, 1879.
- 225,071. ELECTRIC GAS LIGHTING DEVICE. Henry F. Packard, Brockton, Mass., assignor to Abraham L. Bogart, Jamaica, N. Y. Filed Jan. 11, 1878.

March 9.

- 225,435. APPARATUS FOR ENRICHING AND ECONOMIZING COAL GAS. George S. Strong, Port Hope, Ontario, Canada. Filed June 16, 1879.

March 23.

- 225,740. BURNER FOR GAS STOVE. William Bliesner, St. Louis, Mo. Filed Jan. 21, 1880.
- 225,778. GAS ENGINE. Wilhelm Wittig and Wilhelm Hees, Hanover, Prussia, German Empire. Filed Dec. 11, 1879.
- 225,813. GAS PRODUCER. Adolph Faber du Faux, Newark, N. J., assignor to Edward Cooper and Abraham S. Hewitt, New York, N. Y. Filed Oct. 17, 1879.

March 30.

- 226,001. METHODS OF CHARGING GAS RETORTS WITH HYDROCARBON OILS. Adolph Riebeck, Leipsic, Saxony, German Empire. Filed Dec. 5, 1879. Patented in Germany July 25, 1879; in England Oct. 4, 1879; and in France Aug. 10, 1879.
- 226,122. CARBURETING APPARATUS. Guillaume Smyers, Brussels, Belgium. Filed Nov. 4, 1879.

April 6.

- 226,292. PRICE INDICATOR FOR GAS OR FLUID METERS. Frederic Egner, Norfolk, Va. Filed Feb. 5, 1880.

April 13.

- 226,397. PROCESS AND APPARATUS FOR MANUFACTURING GAS. Mahlon S. Frost, Philadelphia, Pa. Filed Apr. 21, 1879.
 226,472. GENERATOR FOR PRODUCING CARBURETED WATER GAS. John D. Averell, New York, N. Y. Filed Aug. 14, 1879.
 226,479. GAS GOVERNOR. Llwellyn P. Blair, Wilmington, Del., assignor of one-half his right to William D. Dewe, same place. Filed Feb. 11, 1880.
 226,561. CARBURETER. Miles S. Wright, Brooklyn, N. Y., assignor of one-half his right to James D. Merritt, same place. Filed Aug. 25, 1879.

April 20.

- 226,816. VAPOR BURNER. Joseph S. Wood, Brooklyn, N. Y., assignor to himself and Dio Dekremen, same place. Filed Dec. 1, 1879.

April 27.

- 226,875. GAS CARBURETER. James M. Palmer, Cambridge, Mass. Filed Jan. 30, 1880.
 226,972. GAS ENGINE. Edward Buss, Arbon, Switzerland, assignor to Charles Max Sombart, Magdeburg, Prussia. Filed Jan. 31, 1880. Patented in Germany, Mar. 28, 1879.

May 4.

- 227,234. GAS PRESSURE REGULATOR. John M. Foster, Philadelphia, Pa. Filed Aug. 18, 1879.

May 11.

- 227,412. PIPE FOR DRAINS, GAS AND WATER. Mortimer M. Camp, New Haven, Conn. Filed Mar. 1, 1880.
 227,502. APPARATUS FOR MAKING ILLUMINATING GAS. William H. Douglass, Cleveland, Ohio, assignor to James Grant, same place. Filed Sept. 26, 1879.
 227,547. APPARATUS FOR ENRICHING GAS. James Livesey, Joshua Kidd and James Kidd, London, England. Filed Feb. 25, 1880.
 227,548. APPARATUS FOR ENRICHING GAS. James Livesey, Joshua Kidd and James Kidd, London, England. Filed Feb. 25, 1880.

227,549. APPARATUS FOR ENRICHING GAS. James Livesey, Joshua Kidd and James Kidd, London, England. Filed Feb. 25, 1880. Patented in England July 2, 1879.

May 18.

227,695. VAPOR BURNER. Fordyce A. Lyman, Cleveland, Ohio. Filed Feb. 27, 1880.

227,701. GASOLINE BURNER. William C. North, Cleveland, Ohio. Filed Mar. 11, 1880.

227,783. GAS METER. Thomas C. Hopper, Philadelphia, Pa., assignor to the American Meter Co., same place. Filed Mar. 24, 1880.

227,853. CARBURETER. Charles W. Soule, Boston, Mass., assignor of one-half his right to Frank R. Kimball, Salem, Mass. Filed Feb. 2, 1880.

227,867. GAS PRESSURE REGULATOR AND INDICATOR. Frederick W. Wiesebrock, New York, N. Y. Filed Apr. 12, 1880.

May 25.

228,079. GAS REGULATOR. Peter Keller, Chicago, Ill. Filed Oct. 13, 1879.

June 1.

228,392. PROCESS FOR MAKING ILLUMINATING GAS. Thomas J. F. Regan, Brooklyn, N. Y., assignor to Frank S. Benson, same place. Filed Jan. 16, 1880.

June 8.

228,513. GAS METER. Azariah Carpenter, New York, N. Y., assignor to the American Meter Co., same place. Filed May 13, 1879.

228,547. GAS APPARATUS. Hiram S. Maxim, Brooklyn, N. Y., assignor to Spencer D. Schuyler, New York, N. Y. Filed Dec. 22, 1879.

June 15.

228,765. GAS CLEANING APPARATUS. Martin Kennedy, Chicago, Ill. Filed Dec. 27, 1879.

228,848. GAS APPARATUS. Joseph S. Wood, Brooklyn, N. Y. Filed Dec. 4, 1879.

June 22.

229,034. APPARATUS FOR PRODUCING HYDROCARBON GAS. Eugene Egasse, Paris, France. Filed Feb. 11, 1880. Patented in France Feb. 2, 1878.

June 29.

- 229,344. GAS GENERATOR FOR HYDROCARBON FURNACES. Alfred F. Watkins, Baltimore, Md., assignor of a part of his right to Samuel H. Adams, John F. Adams and John Savage Williams, same place. Filed July 29, 1879.
- 229,346. CARBURETER. George Westinghouse, Jr, Pittsburg, Pa. Filed Feb. 26, 1880.
- 229,409. GAS REGULATING BURNER. George J. Hickey, Waterloo, Iowa., assignor of one-half his right to B. G. Button, same place. Filed Apr. 17, 1880.
- 229,444. GAS BURNER. Henry W. Merritt, Somerville, Mass., assignor to William H. Ireland, Boston, Mass. Filed May 1, 1880.
- 229,454. VAPOR BURNER. William R. Park, Philadelphia, Pa., assignor of one-half his right to Robert W. Park, same place. Filed Apr. 26, 1880.

July 6.

- 229,765. MULTIPLE GAS BURNER. Albert M. Silber, London, England. Filed Jan. 28, 1880. Patented in England Aug. 7, 1879.

July 13.

- 229,799. VAPOR BURNER. George W. Billings, Cleveland, Ohio. Filed Sept. 30, 1879.
- 230,060. SMOKE BELL SUPPORT FOR GAS FIXTURES. George S. Roberts, Baltimore, Md. Filed May 6, 1880.

July 27.

- 230,470. GAS MOTOR ENGINE. Dugald Clerk, Glasgow, North Britain. Filed Feb. 18, 1880. Patented in England Aug. 1, 1878.
- 230,567. ELECTRIC GAS LIGHTING APPARATUS. George F. Pinkham, Quincy, Jacob P. Tirrell, Somerville, and Warren S. Hill, Hyde Park, assignors to George F. Pinkham, Quincy, Mass. Filed May 22, 1880.
- 230,584. VAPOR BURNER. Willard H. Smith, Brooklyn, N. Y. Filed Apr. 5, 1880.
- 230,589. ELECTRIC GAS LIGHTING APPARATUS. Jacob P. Tirrell, Somerville, assignor to George F. Pinkham, Quincy, Mass. Filed May 22, 1880.
- 230,590. ELECTRIC GAS LIGHTING APPARATUS. Jacob P. Tirrell, Somerville, assignor to George F. Pinkham, Quincy, Mass. Filed May 22, 1880.

August 3.

- 230,656. CARBURETER. Bernard Radkey, Austin, Texas. Filed Apr. 10, 1880.
- 230,657. APPARATUS FOR THE MANUFACTURE OF WOOD AND OIL GAS. George Ramsdell, Oswego, N. Y. Filed May 1, 1880.
- 230,744. GAS GOVERNOR AND REGULATOR FOR CARBURETER. Albert F. Chace, Boston, Mass. Filed Apr. 17, 1880.
- 230,846. GAS REGULATOR. Moses G. Wilder, Brooklyn, N. Y. Filed Jan. 21, 1880.

August 10.

- 230,921. VAPOR AND OTHER ENGINE. Herbert Cottrell, Newark, N. J. Filed Mar. 27, 1880.
- 231,075. VAPOR BURNER. Hugh L. McAvoy, Baltimore, Md., assignor of three-fourths his right to James Fryer, Baltimore County, Md. Filed Mar. 17, 1880.

August 17.

- 231,177. APPARATUS FOR THE PURIFICATION OF COAL GAS. August Klönne, Dortmund, Prussia. Filed Aug. 22, 1878. Patented in Germany Oct. 20, 1877, and in England Nov. 9, 1877.
- 231,224. VAPOR BURNER. Paul Hiekisch, Decatur, Ill. Filed June 17, 1880.
- 231,256. GAS BURNER. John F. Barker, Springfield, Mass. Filed May 13, 1879.
- 231,344. COMBINED APPARATUS FOR PRODUCING ILLUMINATING GAS AND GENERATING STEAM. James H. Needles, Columbus, Ohio, assignor of one-half his right to George S. Woodruff and John M. Egan, Toronto, Canada. Filed May 15, 1880.
- 231,423. APPARATUS FOR MAKING ILLUMINATING GAS FROM HYDRO-CARBON LIQUID AND WATER. Ezekiel B. Holmes, Canandaigua, N. Y. Filed June 1, 1880.
- 231,635. APPARATUS FOR CARBURETING AIR OR GASES FOR ILLUMINATING PURPOSES. William West, Madisonville, Ohio. Filed Mar. 3, 1880.

September 7.

- 231,887. VAPOR BURNER. William G. Amor, Cleveland, Ohio. Filed July 3, 1880.
- 231,973. VAPOR BURNER. Paul Schneider and Henry Trenkamp, Cleveland, Ohio. Filed July 21, 1880.

September 14.

- 232,139. VAPOR BURNER. James A. Marsh, Cleveland, Ohio. Filed June 18, 1880.
- 232,243. GAS MOTOR ENGINE. Gottlieb W. Darniler, Deutz-on-Rhine, German Empire. Filed July 13, 1880. Patented in England Jan. 26, 1880.

September 28.

- 232,592. DROP-LIGHT GASALIER. James E. Brown, Williamsburg, assignor to George Pancoast, New York, N. Y. Filed May 1, 1880.
- 232,593. DROP-LIGHT GASALIER. James E. Brown, Williamsburg, assignor to George Pancoast, New York, N. Y. Filed May 1, 1880.
- 232,661. ELECTRIC GAS-LIGHTING APPARATUS. Jacob P. Tirrell, Lexington, Mass. Filed Jan. 8, 1877.

CURRENT GAS LITERATURE.

INDEX OF INTERESTING ARTICLES IN THE CURRENT PERIODICALS OF THE INDUSTRY, FROM OCTOBER 1, 1896, TO OCTOBER 1, 1897.

Papers referred to:—

American Gas Light Journal (A. G. L. J.), New York...	Weekly, \$3 a year.
Progressive Age (P. A.), New York.....	Semi-Monthly, \$3 “
Water and Gas Review (W. & G. R.), New York.....	Monthly, \$1 “
Journal of Gas Lighting, etc. (J. G. L.), London, Eng. .	Weekly, 25s. “
Gas World (G. W.), London, Eng.....	Weekly, 15s. “
Gas Engineer's Magazine (G. E. M.), London, Eng. .	Monthly, 6s. 6d. “
Municipality and County (M. & C.), Buffalo.....	Monthly, \$2 “
Engineering Magazine (E. M.), New York,	
(includes Technical Index),	Monthly, \$3 “
American Manufacturer and Iron World (A. M. I. W.)	Pittsburg.
Sanitary Plumber (S. P.).....	New York.
Cassier's Magazine (C. M.)	“ “
Heating and Ventilation (H. & V.)	“ “
Stevens Indicator (S. I.)	Hoboken, N. J.
Engineering and Mining Journal (E. & M. J.).....	New York.
Street Railway Review (S. R. R.)	Chicago.
Engineering (Eng. Lon.)	London, Eng.
Railway Review (R. R.)	Chicago.
Scientific American Supplement (S. A. S.).....	New York.
Popular Science Monthly (P. S. M.).....	“ “
Engineering Record (E. R.).....	“ “
Iron Age (I. A.).....	“ “

Wisconsin Engineer (Wis. Eng.).....	Madison, Wis.
Iron Trade Review (I. T. R.).....	Cleveland, Ohio.
Mining Industry and Review (M. I. & R.).....	Denver, Col.
Science (Sci.).....	Lancaster, Pa.
American Machinist (A. M.).....	New York.
Engineering News (E. N.).....	" "
Sibley Journal of Engineering (S. J. E.).....	Ithaca, N. Y.
Fire and Water (F. & W.).....	New York.
Le Génie Civil (L. G. C.).....	Paris.
Glaser's Annalen für Gewerbe und Bauwesen (G. A. G. B.)	
Domestic Engineering (D. E.).....	Chicago.
Electricity (Elect.).....	New York.

ORGANIZATION

OF GAS UNDERTAKINGS, INCLUDING THEIR RELATIONS TO MUNICIPALITIES AND THE PUBLIC AS A COMMUNITY.

Dunfermline Arbitration,	G. W., XXV-639-530; 640-562 ; J. G. L., LXVIII-1745-745; 1746-800; 1747-858
Free Gas for Pittsburg, <i>Municipality and County</i> ,	M. & C., 3-10-185
The Projected Municipal Gas Undertaking (Vienna), <i>Journal of Gas Lighting</i> ,	J. G. L., LXVIII-1748-914
The Teignmouth District Council's Gas Works, An Offer to Purchase,	J. G. L., LXVIII-1751-1084
Dollar Gas, <i>Engineering Record</i> ,	A. G. L. J., LXVI-2-42; E. R., Jan. 2, 1897
Something About Municipal Control as Practiced in Hamilton, Ohio,	"Doubter," A. G. L. J., LXVI-2-50
The Gas Question in Vienna, <i>Der Gastechniker</i> ,	J. G. L., LXIX-1757-81
The Transfer of the Matlock Bath Gas Works to the District Council. Report of the Parliamentary and Negotiation Committee, J. G. L., LXIX-1757-81	
The Destructive Tendency of Competition in Public Service Functions,	Fred deLand, A. G. L. J., LXVI-3-88
Municipal Control, C. J. R. Humphreys,	A. G. L. J., LXVI-5-163
State Regulation of Corporations, G. H. Christian,	P. A., XV-4-74; A. G. L. J., LXVI-7-241
Discussion, Ohio Gas Light Association,	P. A., XV-4-75; A. G. L. J., LXVI-8-282
The Assessment of the South Metropolitan Gas Works,	J. G. L., LXIX-1767-567; 1768-726
The Sterling Gas Works Arbitration,	J. G. L., LXIX-1767-670
The Story of Municipal Glasgow, <i>Journal of Gas Lighting</i> ,	J. G. L., LXIX-1768-709
The Philadelphia Gas Works, from a Legislative Point of View,	A. G. L. J., LXVI-19-718
Sterling Burgh Gas Bill, J. G. L., LXIX-1778-1302; G. W., XXVI-671-907	

- City Gas Making a Failure, Report of the Committee That Investigated Philadelphia's Municipal Affairs. W. & G. R., VII-11-21
- The Chicago Gas Situation, *Progressive Age*, P. A., XV-12-255
- The Taxation of Gas by Local Authorities, Isaac Carr, J. G. L., LXX-1783-92;
G. E. M. Supplement, June 1897-31; G. W., XXVI-674-1054
- Is the Municipalization of Gas Undertakings Advantageous? Herbert Lees,
J. G. L. LXX-1783-95; G. W., XXVI-674-1056
G. E. M., Sup. June 1897-33
- The Gas Question in Vienna. J. G. L., LXIX-1780-1431
- New York City Should Own the Gas Supply, Edward M. Grout,
N. Y. Sun, Apr. 1, 1897; P. A., XV-13-294
- Municipal Lighting, W. Worth Bean, (Abstract), P. A., XV-13-302
- The St. Annes-on-the-Sea Gas Bill,
G. W., XXVII-676-24; J. G. L., LXX-1784-169
- Municipal Ownership of Electric Light Plants, M. J. Francisco,
A. G. L. J., LXVII-1-7
- No Government Should Operate an Industry, Allen R. Foote,
P. A., XV-14-314; 15-334; 16-354
- Text of a Pennsylvania Bill to Protect Lighting Properties,
P. A., XV-15-344; A. G. L. J., LXVII-4-128
- The Reform of Gas Works Rating, *Journal of Gas Lighting*,
J. G. L., LXX-1784-159
- Municipal Lighting in the United States, F. W. Cappelen,
Jour. Ass'n of Eng. Soc., May, 1897
- Ashford Gas Arbitration, G. W., XXVII-680-179; J. G. L., LXX-1786-280
- The Municipal Control Discussion, *Progressive Age*, P. A., XV-16-352
- The Municipal Ownership Problem, *Progressive Age*, P. A., XV-16-366
- A Practical Tax Example, St. Paul, Minn., *American Gas Light Journal*,
A. G. L. J., LXVII-7-241
- Municipal Control, C. W. Quilty, A. G. L. J., LXVII-8-286
- Leamington Gas Works Purchase Question, Report by Thomas Newbigging,
J. G. L., LXX-1789-444
- The Purchase of the Matlock Bath Gas Works by the District Council, The
Cost of the Transfer, J. G. L., LXX-1789-445
- An Assessment Epidemic, *Progressive Age*, P. A., XX-17-375
- Association for the Public Control of Franchises, P. A. XV-17-386
- Convention of Municipal Officials, *Progressive Age*, P. A., XV-17-389
- Regulatory Acts by City Councils—The Indianapolis and Other Cases,
Progressive Age, P. A. XV-18-396
- The Waste in Competition in Public Service Functions,
John Walter Bourke, P. A., XV-18-408
- Private Control of Gas in Philadelphia, *Progressive Age*, P. A., XV-18-414
- Mayor McMurray's Veto of the Opposition Charter for Denver, Col.
A. G. L. J., LXVII-12-447
- The Offer of the Denver Consolidated Gas Company to the City.
A. G. L. J., LXVII-12-449

The Leamington Gas Works Purchase Question,	The Proposal Abandoned,
	J. G. L., LXX-1793-638
Gas Acts for 1897,	J. G. L., LXX-1794-675
The Ambleside Gas Works Arbitration,	J. G. L., LXX-1794-688

FINANCE,

INCLUDING MATTERS OF CAPITAL, PURCHASE, SALES, COLLECTIONS, ETC.

Analysis of the Tottenham and Edmonton Gas Light and Coke Company's Accounts,	G. W., XXVI-659-381
Analysis of the Commercial Gas Company's Accounts,	G. W., XXV-637-451
Analysis of the Alliance and Dublin Consumers' Gas Company's Accounts,	G. W., XXV-637-452
Analysis of the Carlisle Corporation Gas Accounts,	G. W., XXV-638-497
Analysis of the Croydon Commercial Gas and Coke Company's Accounts,	G. W., XXV-639-526
Analysis of the Hastings and St. Leonards Gas Company's Accounts,	G. W., XXV-640-559
Analysis of the Salford Corporation's Gas Accounts,	G. W., XXV-641-591
Analysis of the Liverpool United Gas Light Company's Accounts,	G. W., XXV-642-629
Analysis of the Bromley Gas Consumers' Company's Accounts,	G. W., XXV-642-630
Analysis of the Birmingham Corporation's Gas Accounts,	G. W., XXV-643-676
Analysis of the Brighton and Hove General Gas Company's Accounts,	G. W., XXV-643-677
Analysis of the Newcastle-upon-Tyne and Gateshead Gas Company's Accounts,	G. W., XXV-644-707
Analysis of the Bradford Corporation's Gas Accounts,	G. W., XXV-645-745
Analysis of the Stafford Corporation,	G. W., XXV-647-825
Analysis of the Sheffield United Gas Light Company,	G. W., XXVI-650-23
The Gas Light and Coke Company's Accounts,	G. W., XXVI-654-163
Analysis of the Gas Light and Coke Company's Accounts,	G. W., XXVI-654-164
Cheat the Gas Companies, <i>Water and Gas Review</i> ,	W. & G. R., VII-7-17
The Gas Light and Coke Company, The Half-Yearly Report and Accounts,	J. G. L., LXIX-1760-242-3
South Metropolitan Gas Company, The Half-Yearly Report and Accounts,	J. G. L., LXIX-1761-301-2
Brentford Gas Company, The Half-Yearly Report and Accounts,	J. G. L., LXIX-1761-303
Analysis of the South Metropolitan Gas Company's Accounts,	G. W., XXVI-656-244
Analysis of the Newcastle-upon-Tyne and Gateshead Gas Company's Accounts,	G. W., XXVI-662-449
Commercial Gas Company, Report and Accounts,	J. G. L., LXIX-1768-731

- Analysis of the Commercial Gas Company's Accounts, G. W., XXVI-664-586
 Accounts of the Metropolitan Gas Companies for the Year 1896,
 J. G. L., LXIX-1770-826
 Paris Gas Company, Report and Accounts for the Year 1896,
 J. G. L., LXIX-1772-952
 Cost of Illuminating Gas in Belfast, James B. Taney, Consular Report, April,
 1897, P. A., XV-9-192
 Analysis of the Heywood Corporation's Gas Accounts, G. W., XXVI-672-943
 Analysis of the Bolton Corporation's Gas Accounts, G. W., XXVI-673-976
 The Portland Gas Company's Affairs, P. A., XV-12-283
 Analysis of the Wigan Corporation's Gas Accounts, G. W., XXVI-675-1095
 Paris Gas Accounts, G. W., XXVII-676-20
 Analysis of the West Bromwich Corporation's Gas Accounts,
 G. W., XXVII-677-64
 Manchester Corporation Gas and Electric Light Supply, Annual Accounts,
 J. G. L., LXX-1783-124
 Ramsgate Corporation Gas and Water Supply, The Annual Accounts,
 J. G. L., LXX-1783-126
 Analysis of the Accounts of Certain Gas Undertakings of England, Scotland
 and Ireland, for the Year 1896, John W. Field,
 G. E. M., XII-254-214
 Analysis of the Manchester Corporation's Gas Accounts,
 G. W., XXVII-678-92
 Analysis of the Darwen Corporation's Gas Accounts, G. W., XXVII-678-93
 Southport Corporation Gas Supply, The Annual Accounts,
 J. G. L., LXX-1784-178
 Analysis of the Stoke-upon-Trent Corporation's Gas Accounts,
 G. W., XXVII-679-130
 The Gas Light and Coke Company's Accounts,
 J. G. L., LXX-1786-262-277; G. W., XXVII-680-166
 Analysis of the Gas Light and Coke Company's Accounts,
 G. W., XXVII-680-168
 The South Metropolitan Report and Accounts,
 G. W., XXVII-681-204; J. G. L., LXX-1786-263-278
 Analysis of the South Metropolitan Gas Company's Accounts,
 G. W., XXVII-681-205
 Analysis of the Nottingham Corporation's Gas Accounts,
 G. W., XXVII-681-206
 Brentford Gas Company, Half-Yearly Report and Accounts,
 J. G. L., LXX-1787-338
 Analysis of the Bradford Corporation's Gas Accounts,
 G. W., XXVII-683-290
 Analysis of the Crystal Palace District Gas Company's Accounts,
 G. W., XXVII-684-317
 Analysis of the Tottenham and Edmonton Gas Light and Coke Company's
 Accounts, G. W., XXVII-685-352
 Analysis of the Stafford Corporation's Gas Accounts, G. W., XXVII-686-390
 Analysis of the Brentford Gas Company's Accounts, G. W., XXVII-687-428

Analysis of the Colne Corporation's Gas Works Accounts.

G. W., XXVII-687-429

Accounts of the South Metropolitan Gas Company, G. E. M., XIV-256-1

Analysis of the Carlisle Corporation's Gas Accounts, G. W., XXVII-688-468

PROCESS,

RELATING TO SPECIAL METHODS OF GAS PRODUCTION.

Pinkneys Apparatus for Producing Gas, Patent Specification,

A. G. L. J., LXV-14-529

The Future of Producer Gas, A. Humboldt Sexton, A.M.I.W., LIX-15-516

New Fuel Gas Process, *Times-Herald, Chicago*,

G. E. M., XIII-246-52; A. M. I. W., LIX-16-553

New System of Gas Lighting,

A. M. I. W., LIX-17-589

A French Gas Making Process, M. Loevenbruck, G. E. M., XIII-245-38

Thwaite's Motor Gas Process,

Eng. Lon., Aug. 28, 1896

Gas Power Transmission (Editorial),

R. R., Aug. 15, 1896

Fuel Gas from Anthracite Coal, J. Gardner,

A. G. L. J., LXV-20-768; A. M. I. W., LIX-19-663

New Gas and Coke Making Plant at Halifax, N. S.,

Journal of Gas Lighting, J. G. L., LXVIII-1754-1234

The Water Gas Question in Europe, Hugo Strache, A. M. I. W., LX-3-87

Notes on Carburetted Water Gas, A. G. Glasgow,

J. G. L., LXIX-1758-124; G. W., XXVI-652-90

A New Loomis Fuel Gas Plant, The Citizens' Gas Company of Bridgeport,
Conn. I. A., Nov. 19, 1896

Carburetted Water Gas, A. G. Glasgow, A. M. I. W., LX-6-193

On the Application of Oil for the Production of Illuminating Gas,

Mr. Hunt, J. G. L., LXIX-1764-466

Carburetted Water Gas, J. Stelfox,

G. W., XXVI-660-410; J. G. L., LXIX-1765-535

The Oil Gas Process at Huddersfield, W. R. Herring,

J. G. L., LXIX-1765-535

The Dellwik Gas Producer, Mr. Dicke, (Abstract), A. M. I. W., LX-12-410

Carburetted Water Gas, J. T. Westcott,

J. G. L., LXIX-1767-648; G. W., XXVI-661-454

The Inclined Retort Patents. Automatic Coal Gas Retort Company, Limited,
v. The Corporation of Salford,

J. G. L., LXIX-1767-563; 1768-722; G. W., XXVI-661-461; 662-502

The Mond Gas Producer Plant, H. A. Humphrey, (Abstract),

A. M. I. W., LX-15-517; J. G. L., LXIX-1767-653

The Coze Patent Upheld,

A. G. L. J., LXVI-16-607

Gas World, G. W., XXVI-662-491

Journal of Gas Lighting, J. G. L., LXIX-1768-705

Water Gas, Hugo Strache, *Wiener Bauindustrie Zeitung*, Jan. 14, 1897

Gas Manufacture and Appliances. Henry O'Connor,

G. W., XXVI-663-538; 664-576; 665-614; 667-688; 669-825; 672-938;

673-978; 675-1088; XXVII-676-16; 678-94

- Observations on Carbureted Water Gas. J. T. Westcott,
A. G. L. J., LXVI-15-562; (Abstract) A. M. I. W., LX-16-555
- Prof. Lewes on Carbureted Water Gas, Report to Birkenhead,
J. G. L., LXIX-1771-893; G. W., XXVI-665-620;
P. A., XV-10-204; A. M. I. W., LX-22-771
- Self-Enrichment of Coal Gas. R. G. Shadbolt,
J. G. L., LXIX-1772-935; G. W., XXVI-666-656
- Notes on Some Recent Forms of Gas Producer, A. H. Sexton,
A. M. I. W., LX-19-659
- The Bates Gas Process, *American Manufacturer*, A. M. I. W., LX-19-661
- Gas from Anthracite Coal, J. Gardner Sanderson, A. M. I. W., LX-22-771
- Carburetted Water Gas, Corbet Woodall,
A. M. I. W., LX-26-913; J. G. L., LXIX-1777-1241;
G. W., XXVI-671-903
- Manufacturing Carburetted Water Gas, Patent Specifications,
J. G. L., LXIX-1777-1249
- A Study of Inclined Retorts in Europe. Frederic Egner,
A. G. L. J., LXVI-22-861; P. A., XV-11-236;
G. W., XXVI-673-985; J. G. L., LXIX-1779-1355
- Discussion,
A. G. L. J., LXVI-22-861; P. A., XV-11-237
- The Failure of the Commercial Attempts to Supply Fuel Gas in the United States, F. H. Shelton, P. A., XV-12-259; A. G. L. J., LXVI-23-903
- Discussion, Western Association,
P. A., XV-12-265; A. G. L. J., LXVI-23-910
- The Critic Criticised, Edwin B. Donkin, (Refers to Henry O'Connor's Article on Exhausters.)
G. W., XXVI-673-975
- Inclined Retorts (Communication) Frederic Egner, J. G. L., LXX-1782-36;
G. W. XXVII-677-54; A. G. L. J., LXVI-24-964.
- The Fuel Gas Failures, *Progressive Age*, P. A., XV-12-256
- An Additional Chapter on Inclined Retorts, Frederic Egner,
A. G. L. J., LXVI-25-1002
- Fuel Gas, An Analysis of Harris Gas, H. L. Payne,
P. A., XV-13-303; A. G. L. J., LXVI-25-1006
- A New Gas Making Engine, *American Manufacturer*, A. M. I. W., LXI-1-15
- Some Notes on An English Oil Gas Process, F. Egner,
A. G. L. J., LXVII-1-2
- Inclined vs. Horizontal Retorts: A Comparison, Dr. Moss,
A. G. L. J., LXVII-1-12
- On Three Years' Use of Carburine as an Enricher, Joseph Davis,
J. G. L., LXX-1782-19
- Arithmetic and Chemistry Support Mr. Shelton's Contention in Respect of Fuel Gas, J. P. Gill,
A. G. L. J., LXVII-3-82
- Dellwik Gas Producer, Mr. Dicke, (Abstract), G. E. M., XIII-254-216
- Producer vs. Water Gas, Vivian B. Lewes, (Extract), A. M. I. W., LXI-5-157
- Fuel Gas, Arthur Kitson, Trans. of Asso. of Civ. Eng. of Cornell University,
June, 1897,

- The Dellwik Water Gas Process, E. Fleischer, (Condensed)
P. A., XV-17-378; G. W., XXVII-681-207
- A Comparison of Fuel Gas Processes, F. L. Slocum,
J. G. L., LXX-1788-379; A. M. I. W., LXI-7-231; 8-267; 9-302
- Changing a Coal Gas System to the Use of Natural Gas, John Kempf, Jr.,
A. M. I. W., LXI-10-337; A. G. L. J., LXVII-7-248
- Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-7-249
- Carburetted Water Gas, Prof. Macadam,
G. W., XXVII-683-283; J. G. L., LXX-1788-376
- Carburetted Water Gas Apparatus, Patent Specifications,
J. G. L., LXX-1788-385; 1790-486
- Inclined Retorts at Brentford, G. W., XXVII-683-289
- A Difference in Hydraulic Mains, P. Egan, P. A., XV-17-389
- Manufacture of Illuminating Gas, Patent Specifications,
J. G. L., LXX-1792-588
- Discussing Gas Producers, A. M. I. W., LXI-13-445
- The Dauber Gas Generator, J. G. L., LXX-1794-684

PLANT,

INCLUDING MATTERS OF LOCATION, DESIGN, CONSTRUCTION AND REPAIRS.

- Observations on the Construction and Working of Regenerator Settings,
W. J. Jenkins, A. G. L. J., LXV-15-566
- Inclined Retorts at Cassel, Emil Merz, (Abstract), J. G. L., LXVIII-1744-691
- Fire Clay *vs.* Fire Brick Gas Retorts, J. Golding, (Extract),
J. G. L., LXVIII-1745-740
- Carburetted Water Gas at Southport, *Gas Engineers' Magazine*,
G. E. M., XIII-245-30
- The Belfast Gas Works, James Stelfox,
Eng. Lon. Aug. 28, 1897; P. A., XIV-20-455; 21-497
- A Modern Retort House, W. A. Miller,
P. A., XIV-21-490; A. G. L. J., LXV-22-848; J. G. L., LXVIII-1748-902
- Inclined Retorts up to Date, Frederic Egner,
P. A., XIV-21-481; A. G. L. J., LXV-21-802; J. G. L., LXVIII-1748-904;
(Abstract), G. W., XXV-644-708
- Regenerative Furnaces for Small Gas Works, W. R. Randall,
A. G. L. J., LXV-24-930; J. G. L., LXVIII-1749-963;
G. W., XXV-643-671; G. E. M., XIII-249-108
- Mr. Egner's Paper on Inclined Retorts, *Journal of Gas Lighting*,
J. G. L., LXVIII-1749-956
- Report of the Committee on Inclined Retorts, Specially Elected by the German
Association (Referred to in Frederic Egner's paper) (Abstract Trans.),
J. G. L., LXVIII-1750-1017
- A Supplement to the Discussion before the American Association on Inclined
Retorts up to Date, Frederic Egner, A. G. L. J., LXV-23-897
- A New Stack of Benches at the Portland (Me.) Works. By "Retort,"
J. G. L., LXIX-1757-77; A. G. L. J., LXV-24-927

- The Problem of Power Transmission and Distribution,
Journal of Gas Lighting, J. G. L., LXVIII-1753-1176
- An American Retort House, William S. Miller, (Abstract),
 G. W., XXV-648-866
- Wood's Safety Device for Gas Producers, Patent Specifications,
 A. G. L. J., LXV-25-967
- Rustless Coatings for Iron and Steel, M. P. Wood,
 A. G. L. J., LXV-25-973
- Swindells' Improved Gas Producer, Patent Specifications,
 A. G. L. J., LXV-26-1012
- The New Chimney at the Edinburgh Gas Works,
 J. G. L., LXVIII-1755-1297
- The Holmes Apparatus for Washing Gas, Patent Specifications,
 A. G. L. J., LXVI-4-125
- Drum Pump, Blower and Gas Exhauster, etc., G. E. M., XIII-248-95
- Pipes and Piping: Patterns, Materials and Methods Best Suited for Plant and
 Line Construction and Maintenance, C. P. Russell,
 A. G. L. J., LXVI-5-163
- The Installation of Carburetted Water Gas Plant, Birmingham,
Journal of Gas Lighting, J. G. L., LXIX-1760-233
- Gas Manufacture and Appliances, Henry O'Connor,
 G. W., XXVI-655-201; 657-289; 658-338; 660-411; 662-493; 663-538;
 664-576; 665-614; 667-688; 669-825; 672-938; 673-978; 675-1088;
 XXVII-676-16; 678-94; 680-166; 681-209; 683-281; 684-318; 685-357
- The Duplication of the Water Gas Plant at Birmingham,
 J. G. L., LXIX-1761-305
- Brentford and the Inclined Retort System, J. G. L., LXIX-1762-338
- Production of Coal and Coke in Tennessee in 1896, A. H. Wood, (Abstract)
 A. M. I. W., LX-10-336
- The Inclined Retort Patents, Automatic Coal Gas Retort Company, Limited,
vs. The Corporation of Salford, J. G. L., LXIX-1767-563; 1768-722
 G. W., XXVI-661-461; 662-502
- The Coze Patent Upheld,
Gas World, G. W., XXVI-662-491
Journal of Gas Lighting, J. G. L., LXIX-1768-705
- On the Arrangement and Computation of Tie Rods in Condensers,
 Rudolph Leupold, P. A., XV-9-183
- The Amsterdam Gas Works, Henry H. Solomons,
 J. G. L., LXIX-1775-1129; G. W., XXVI-668-779
- A Study of Inclined Retorts in Europe, Frederic Egner,
 G. W., XXVI-673-985; J. G. L., LXIX-1779-1355;
 P. A., XV-11-236; A. G. L. J., LXVI-22-861
- Discussion, Western Association,
 A. G. L. J., LXVI-22-861; P. A., XV-11-237
- The Critic Criticised, Edwin B. Donkin, (Refers to Henry O'Connor's
 Article on Exhausters), G. W., XXVI-673-975
- Aird's "Express" Lock Joint, J. G. L., LXIX-1779-1358

- Kendall Corporation Gas Works, Walter R. Wilson,
G. E. M., XIII-253-195
Walker's Self-Sealing Lids, P. A., XV-13-305
Inclined Retorts, (Communication), Frederic Egner,
J. G. L., LXX-1782-36; G. W., XXVII-677-54;
A. G. L. J., LXVI-24-964
Coatings for Iron, *Kraft und Licht*, P. A., XV-14-313
The "Weardale" and Other Gas Furnaces, *Journal of Gas Lighting*,
J. G. L., LXX-1783-107
The Use of the Kudlicz Grate for Burning Breeze, Cinders and Other Fuel
Residues, M. Jouanne, (Abstract Trans.) J. G. L., LXX-1783-109
A Hinged Scoop for Charging Retorts, M. Laurain, (Abstract Trans.),
J. G. L., LXX-1783-110
Adapting Existing Retort Houses to Mechanical Stoking and Mechanically
Quenching and Removing the Coke, M. Leclaire,
J. G. L., LXX-1783-110
Furnace Jottings, Maurice Graham, A. G. L. J., LXVII-4-129
Regenerative Furnaces for Heating Gas Retorts, Patent Specifications,
G. W., XXVII-679-139
Bristol's New Atmospheric Range Recording Thermometer for Closed Spaces,
A. G. L. J., LXVII-5-167
Abandonment of the Inclined Retort Patent Appeal, J. G. L., LXX-1785-208
The Amsterdam Gas Works, Henry H. Solomons, A. G. L. J., LXVII-6-202
A Difference in Hydraulic Mains, P. Egan, A. G. L. J., LXVII-11-412;
J. G. L., LXX-1789-432; G. W., XXVII-682-245
A Short History of a Long Life, C. M. Converse, A. G. L. J., LXVII-8-289
Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-8-289
Recuperator Benches for Coke and Coal Firing,
Daniel R. Russell, A. G. L. J., LXVII-8-290
Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-8-292
Clay Retorts, Oscar B. Weber, A. G. L. J., LXVII-9-322
Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-9-322
Experiences with Regenerative Settings, Frank Prentice,
G. W., XXVII-687-430; J. G. L., LXX-1792-580
Preservative Paints for Iron Work, Max Toltz, (Extract),
J. G. L., LXX-1793-630

MATERIAL,

INCLUDING PRODUCTION, COMPARISON, HANDLING, STORAGE, ETC.

- West Virginia Coke Production, Joseph D. Weeks,
A. G. L. J., LXV-16-609
Determination of the Calorific Value of Fuels, Walther Hempel,
A. M. I. W., LIX-17-588
Coke Production of Alabama, Joseph D. Weeks, A. G. L. J., LXV-17-649
Commercial Testing of Gas Coal, Thomas Glover,
A. G. L. J., LXV-20-769; J. G. L., LXVIII-1747-847;
G. W., XXV-641-597

- A Use for Carbonic Acid Snow in Coal Heaps, *Journal of Gas Lighting*,
J. G. L., LXVIII-1749-957
- The World's Oil Supply, *Engineering*,
A. M. I. W., LIX-22-770
- Testing Gas Coal, Norton H. Humphrys,
A. G. L. J., LXVI-3-83; J. G. L., LXVIII-1755-1286
- Coal Dust and Colliery Explosions, Donald M. D. Stuart, (Epitome),
J. G. L., LXVIII-1755-1288
- Safe and Unsafe Oils, Stevenson Macadam, (Abstract),
A. M. I. W., LX-8-266; J. G. L., LXVIII-1755-1289
- Coal in Montana, *American Manufacturer*,
A. G. L. J., LXVI-1-11
- The Proximate Constituents of Coal, Report of the British Association's
Committee, J. G. L., LXIX-1756-22
- Wyoming Oil, *American Manufacturer*,
A. M. I. W., LX-2-51
- Petroleum Product in 1896, *American Manufacturer*,
A. M. I. W., LX-2-51
- The Spontaneous Ignition of Coal Cargoes,
Vivian B. Lewes, P. A., XV-2-25
Prof. Meden, P. A., XIV-20-441
- The Improvement of Coal Hauling Machinery, Reuben Street,
A. G. L. J., LXVI-3-87
- The Scotch Shale Oil Industry, *American Manufacturer*,
A. M. I. W., LX-5-159
- Solidified Petroleum, *Gas Engineer's Magazine*,
G. E. M., XIII-248-91
- Burmese Coal, *Progressive Age*,
P. A., XIV-19-429
- The Soft Coal Pool, *Progressive Age*,
P. A., XIV-21-470
- The Testing of Coals, Arthur Winslow,
P. A., XIV-22-519
- Determination of Sulphur in Coke and Coal, Shtolba,
P. A., XIV-24-560
- American Petroleum in Italy,
P. A., XV-3-49
- Artificial and Natural Petroleum, Francis Laur,
P. A., XV-3-52
- The Ontario Oil Field, *Canadian Mining Review*,
A. M. I. W., LX-6-195
- Utah Coal, J. M. Goodwin,
A. M. I. W., LX-11-373
- The Largest Electric Coal Mining Plant in the World,
American Manufacturer,
A. M. I. W., LX-12-408
- Constituents of Petroleum, Charles F. Mabery,
A. M. I. W., LX-12-409
- Determining the Gas Making Value of Mineral Oil,
F. Helfers, (Abstract Trans.)
J. G. L., LXIX, 1767-650
- Coal Formation in Iowa, Extract from Report of the State Geological Corps,
A. G. L. J., LXVI-14-530; A. M. I. W., LX-13-445
- Canadian Petroleum Fields,
P. A., XV-7-137
- Calorific Value of Certain Coals as Determined by the Mahler Calorimeter,
N. W. Lord and F. Haas, (Abstract),
A. M. I. W., LX-15-516
- The Production of Coal: Its Consumption and Cost, *Engineering*,
A. G. L. J., LXVI-15-565
- The Use of "Manjak" in the Manufacture of Coal Gas, Jos. Harger Pye,
J. G. L., LXIX-1771-882
- The Ingrey Coal Weighing and Recording Machine, *Engineering*,
A. G. L. J., LXVI-17-643

- Tennessee's Coal Production, From State Mine Inspector A. H. Wood's Report, A. G. L. J., LXVI-18-683
- Modern Methods of Handling and Storing Coals, F. D. Marshall, J. G. L., LXIX-1775-1120; G. W., XXVI-668-770
- California Petroleum, *American Manufacturer*, A. M. I. W., LX-20-697
- Fight Between Oil Producers and Gas Consumers, A. M. I. W., LX-22-770
- The Uses to Which Petroleum Products are Put, Messrs. Riche and Halpin, (Resumé.) L. G. C., Apr. 3, 1897; P. A., XV-11-246
- Commercial Benzols, *Chemiker Zeitung*, J. G. L., LXIX-1777-1248
- Coal Production of United States in 1896, From E. W. Parker's Report, A. G. L. J., LXVI-26-1041; A. M. I. W., LX-24-841
- Heightening the Flash Point of Light Mineral Oils, *Chem. & Tech. Zeitung* A. M. I. W., LX-24-843
- The Illuminating Value of Benzol, Dr. Krämer, (Extract) J. G. L., LXIX-1780-1421; P. A., XV-12-282
- On Three Years' Use of Carburine as an Enricher, Joseph Davis, G. E. M., Sup. June 1897-25; G. W., XXVI-674-1043
- Petroleum as Steam Engine Fuel, J. A. F. Aspinall, A. M. I. W., LXI-1-13
- Moisture in Coal, *Engineering Record*, A. G. L. J., LXVII-2-55
- Shale Distillation and the Production of Sulphate of Ammonia, *Journal of Gas Lighting*, J. G. L., LXX-1782-38
- Benzol and Its Importance as an Illuminant, Dr. Kraemer, (Summary) A. M. I. W., LXI-4-122
- Bituminous Coal, *Eng. & Mining Journal*, E. & M. J., June 12, 1897
- The Russian Petroleum Trade, James M. Chambers, P. A., XV-16-367
- Spontaneous Ignition of Coal, John L. Howard, A. C. L. J., LXVII-6-210
- Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-7-243
- Gas Engineers' Magazine*, G. E. M., XIII-255-236
- Machine Mining in Ohio, From the Annual Report of R. H. Haseltine, Chief Inspector of Mining, A. G. L. J., LXVII-7-251
- Application of Travelling Belts to the Shipment of Coal, Thomas Wrightson, A. M. I. W., LXI-8-264
- Ohio Coal Production in 1896, From the Annual Report of the Chief Inspector of Mining, A. M. I. W., LXI-8-265
- Petroleum Fires and Explosions, J. G. L., LXX-1790-472
- The Report of the Inspector of Explosives, J. G. L., LXX-1790-475
- Increasing Use of Coal Mining Machines, Extract from Report of E. W. Parker, A. M. I. W., LXI-10-336
- What a Year's Output of Coal Represents. T. A. O'Donahue, (Extract) P. A., XV-18-413
- The Baker Oil Exploitation, *London Standard*, P. A., XV-18-417
- Petroleum Production in 1896, A. M. I. W., LXI-12-411
- The Coal Elevating and Conveying Machinery of the Elland Gas Works, *Engineer*, A. G. L. J., LXVII-12-443
- Pittsburg Mining Scale Adopted, A. M. I. W., LXI-13-446
- Petroleum in Texas, A. M. I. W., LXI-13-447

MANUFACTURE,

COVERING OPERATIONS OF WORKS, FROM STARTING PLANT TO SENDING
OF COMMERCIAL GAS TO STORAGE-HOLDERS.

- Enrichment of Coal Gas, A. F. Browne, J. G. L., LXVIII-1746-796
O. M. Gregory, A. M. I. W., LIX-14-481
John Martin, J. G. L., LXVIII-1745-744
R. G. Shadbolt, A. G. L. J., LXV-15-563; J. G. L., LXVIII-1746-796
The Permanency of Illuminating Gas, Wm. Young,
G. E. M., XIII-247-75; 248-88; J. G. L., LXVIII-1743-647; 1748-911
A Few Words on Naphthaline, John Gimper, G. W., XXV-639-525
To Eliminate Ammonia from Gas, Dr. Bueb, A. M. I. W., LIX-19-663
The Revivification of Foul Oxide, H. Tormin, (Extract),
J. G. L., LXVIII-1750-1014
Carburine as an Enricher, "Engineer" J. G. L., LXVIII-1751-1075
Carless, Capel and Leonard, J. G. L., LXVIII-1752-1133
Wet or Dry Heat—Which Gives Best Results in Purification,
A. E. Forstall, A. G. L. J., LXV-23-890
A Successful Method Devised for Dissipating Naphthaline Deposits,
E. H. Yorke, A. G. L. J., LXV-24-934
Diminution of Naphthaline in Coal Gas, V. O. Keller,
P. A., XIV-24-559; G. E. M., XIII-247-78
Repair of Retorts Whilst in Use, M. Soubiran, (Abstract),
G. E. M., XIII-247-78
Stopped Ascension Pipes, S. Carpenter,
A. G. L. J., LXVI-5-165; J. G. L., LXIX-1757-76
Gas Producers, and the Mechanical Handling of Fuel for same,
C. L. Saunders, P. A., XV-2-38
Revivification or Regeneration of Purifying Material, W. Leybold,
P. A., XV-3-48
The Botley Naphthaline Preventing Process, J. G. L., LXIX-1760-234
Choked Ascension Pipes, "Southerner," J. G. L., LXIX-1760-235
Gas Manufacture and Appliances, Henry O'Connor,
G. W., XXVI-657-289; 658-328; 660-411; 662-493;
XXVII-683-281; 684-318
Stoppages in Ascension Pipes, Norton H. Humphreys,
A. G. L. J., LXVI-18-684; J. G. L., LXIX-1763-403
Scrubber Irrigation, Fr. Burgemeister, A. M. I. W., LX-10-337
Temperature, W. E. McKay, A. G. L. J., LXVI-10-361
Discussion, N. E. Asso. of Gas Engineers, A. G. L. J., LXVI-10-363
The Use of Atmospheric Air with Lime for the Purification of Coal Gas,
S. Carpenter, J. G. L., LXIX-1765-527
The Removal of Graphite from Gas Retorts, *Jour. f. Gasbel.*
A. M. I. W., LX-12-411
Some Naphthalene Experiences, H. Hoffman, Trans. by F. Egner,
A. G. L. J., LXVI-14-519

- Experiences with Naphthalene, J. Barton,
A. G. L. J., LXVI-23-916; J. G. L., LXIX-1772-939;
G. W., XXVI-666-659
- The Use of Lime for Gas Purification, S. Carpenter,
J. G. L., LXIX-1772-932
- The New Retort-House Rules at the Leeds Gas Works,
Journal of Gas Lighting, J. G. L., LXIX-1772-949
- The Carburation of Coal Gas, Charles E. Botley and C. F. Botley,
P. A., XV-14-320; 15-339; 16-359; J. G. L., LXIX-1775-1108;
G. W., XXVI-668-760
- Communication, C. F. Botley, G. W., XXVI-669-823
- Naphthalene and Tar Removal, Henry O'Connor, (Extracts)
P. A., XV-10-209
- Naphthalene Troubles, J. Barton, P. A., XV-10-210
- Revivification of Oxide of Iron in Purifiers, Isaac C. Baxter,
A. G. L. J., LXVI-22-847, P. A., XV-11-223;
Summary, G. W., XXVII-677-53
Discussion, Western Association,
A. G. L. J., LXVI-22-850; P. A., XV-11-227
- On Experiments with the Claus System of Purification at Belfast,
James Stelfox, A. G. L. J., LXVII-14-82; J. G. L., LXIX-1781-1475
G. E. M. Sup., June 1897-9; G. W., XXVI-674-1021
- Naphthalene in Modern Gas Manufacture, and the Carburetting of Illuminating
Gas, William Young and Thomas Glover,
G. E. M. Sup., June 1897-23; G. W., XXVI-674-1040;
A. G. L. J., LXVII-2-49; J. G. L., LXX-1782-16
- Important Questions in the Economic Working of Steam Engines and Boilers.
Bryan Donkin, A. G. L. J., LXVII-1-9
- On Three Years' Use of Carburine as an Enricher, Joseph Davis,
J. G. L., LXX-1782-19
J. G. L., LXX-1782-42
- Naphthalene. Fred E. Linging, J. G. L., LXX-1783-113
- The Claus Process at Belfast, Charles W. Watts, J. G. L., LXX-1783-113
- Simple Tests for Impurities, Henry O'Connor, G. W., XXVII-680-166
- The Eudiometer Test, Henry O'Connor, G. W., XXVII-681-209
- The Best and Most Economical Means of Purifying, D. M. Nelson,
J. G. L., LXX-1787-321; G. W., XXVII-681-215
A. G. L. J., LXVII-12-445
- Noxious Air in Purifying Houses, *Journal of Gas Lighting*,
J. G. L., LXX-1790-474-420
- Removal of Graphite from Retorts, P. A., XV-17-382
- Gas Manufacture and Appliances, Henry O'Connor,
G. W., XXVII-685-357
- Young and Glover's Naphthaline Remedy,
A. G. L. J., LXVII-13-489; G. W., XXVII-686-397
- The Enrichment of Coal Gas, *Journal of Gas Lighting*,
J. G. L., LXX-1791-525

- Notes on the Enrichment of Coal Gas, *Journal of Gas Lighting*,
J. G. L., LXX-1791-528; 1792-585; 1793-633; 1794-679
- The Prevention of Naphthaline Obstructions, *Journal of Gas Lighting*,
J. G. L., LXX-1791-530
- Benzol and Its Importance as an Illuminant, Dr. Kraemer,
G. E. M., XIV-256-21
- Some Practical Observations on Gas Manufacture, S. Carpenter,
J. G. L., LXX-1793-631
- The Enrichment of Coal Gas, Charles Hunt, J. G. L., LXX-1794-688

STORAGE,

INCLUDING MATTERS PERTAINING TO GAS-HOLDERS.

- Preventing Freezing of Gas-Holder Cups, F. M. Harris,
J. G. L., LXVIII-1745-741
- The New Four-Lift Holder of the New York Mutual Gas Light Company,
Walter A. All n,
A. G. L. J., LXV-23-892; (Extracts), J. G. L., LXIX-1756-25
- Wire Rope vs. Guide Frame, *Progressive Age*, P. A., XV-2-23
- The Wrecking of the Laclede Holder, P. A., XIV-22-521
- A Curious Gas Explosion, Irvin Butterworth,
P. A., XV-5-98; A. G. L. J., LXVI-7-246
- Discussion, Ohio Gas Light Association,
A. G. L. J., LXVI-8-288; P. A., XV-5-100
- Accident to the Rope-Guided Gas-Holder at Middlesborough,
P. A., XV-6-115; 7-135; J. G. L., LXIX-1764-486
- Discussion in the Town Council,
J. G. L., LXIX-1766-606; LXX-1783-89; G. W., XXVI-660-424
- Communication, Ashmore, Benson, Pease & Co., Limited,
J. G. L., LXIX-1766-592
- Mr. Henry Woodall's Report,
G. W., XXVII-677-55; J. G. L., LXX-1783-123; P. A., XV-15-342
- Best Condition of Gas Supply, D. Macfie, (Extract),
A. M. I. W., LX-11-374
- Tests of Riveted Jo ints, *Engineering Record*, A. G. L. J., LXVI-13-487
- The "Knell of Columnless Gas-Holders," F. S. Cripps,
P. A., XV-9-190; G. W., XXVI-663-536
- Columnless Gasholders, Ed. Lloyd Pease, G. W., XXVI-664-574
- Gasholder Curbs, Calculation of Strains, John P. Leather,
P. A., XV-10-211; G. W., XXVI-666-650
- The Influence of Wind on Gasholders, M. Irminger,
A. G. L. J., LXVI-23-914; J. G. L., LXIX-1773-986
- A Large Gasholder for Halifax, J. G. L., LXIX-1773-1003
- The Large Treble-Lift Gas-Holder at the Bradford Road Gas Works, Manchester, *Journal of Gas Lighting*, J. G. L., LXIX-1778-1295
- The Inversion of an Untrussed Gasholder Crown, *Journal of Gas Lighting*,
J. G. L., LXIX-1779-1350

- Notes on the Construction and Experience in the Working of the Gadd and
Mason Spiral-Guided Holder at the Chester Gas Works, Robert Hunter,
G. E. M. Sup., June 1897-17; G. W. XXVI-674-1032;
J. G. L., LXIX-1781-1488
- The Wire Rope-Guided Gasholder at Perth, J. G. L., LXIX-1780-1431
- The Spiral-Guided Gasholder at Chester, W. Gadd, J. G. L., LXX-1782-42
- The Middlesborough Gas-Holder Offer to the Contractors,
J. G. L., LXX-1784-178; G. W., XXVII-678-101; P. A., XV-16-363
Communication, R. J. Milbourne, G. W., XXVII-679-128
- Mr. Woodall's Report on the Columnless Gas-Holder Accident,
Progressive Age, P. A., XV-15-332

DISTRIBUTION,

INCLUDING EVERYTHING PERTAINING TO THE HANDLING OF THE GAS FROM
THE HOLDER TO THE CONSUMER'S OUTLET.

- Material and Tools for Main and Service Laying, E. H. Millard,
P. A., XIV-23-540; A. G. L. J., LXV-17-643; G. W., XXV-638-490;
J. G. L., LXVIII-1743-643
- Electrolysis and Gas and Water Pipes, *Gas World*,
P. A., XIV-19-429; G. W., XXV-640-565
- A. P. Trotter on the Electrolytic Corrosion of Gas Mains, *Journal of Gas
Lighting*, W. & G. R., VII-5-23; J. G. L., LXVIII-1746-790
- A Portable Derrick for Pipe Laying, *Engineering News*,
J. G. L., LXVIII-1746-792
- Gas Fittings in Private and Public Buildings, *Gas Engineer's Magazine*,
G. E. M., XIII-245-32
- Prepayment Meters, C. W. Blodgett, A. G. L. J., LXV-22-847
- Service Pipes and Service Piping, T. Littlehales, A. G. L. J., LXV-23-886
Discussion, American Gas Light Association, A. G. L. J., LXV-23-888
- Corrosion Caused by Railway Return Currents, Dugald C. Jackson,
G. W., XXVI-650-22; A. G. L. J., LXV-24-933
- A Successful Method Devised for Dissipating Naphthaline Deposits,
E. H. Yorke, A. G. L. J., LXV-24-934
- Testing Service Pipes. T. Littlehales, G. W., XXV-648-863
- A Coating for Pipes, A. C. Humphreys,
P. A., XV-1-11; G. W., XXV-648-863
- Elusive Leakages from Mains and Services, H. Tobey,
G. E. M., XIII-247-69
- Experiments upon the Distribution of Velocities in Pipes,
M. Basin, (Extract), P. A., XV-1-8
- No More Trouble from Frozen Services, P. A., XV-1-14
- Gas Control from Meter to Burner, D. Macfie,
A. G. L. J., LXVI-6-203; G. W., XXVI-654-167; 655-207;
J. G. L., LXIX-1758-127; P. A., XV-6-124
- The Price of Cast Iron Pipe. *Fire and Water*, P. A., XIV-21-504

- Pipes and Piping; Patterns, Materials and Methods Best Suited for Plant and Line Construction and Maintenance, C. P. Russell,
A. G. L. J., LXVI-5-163; 25-994
- Street Subways, J. G. L., LXIX-1762-343
- Gas Distribution, William H. Snow, A. G. L. J., LXVI-10-358
Discussion, N. E. Asso. of Gas Engineers, A. G. L. J., LXVI-10-360
- Measurement of Gas, C. W. Hinman, A. G. L. J., LXVI-11-401
(Extract), G. W., XXVI-663-554
Discussion, N. E. Asso. of Gas Engineers, A. G. L. J., LXVI-11-403
- Reports of Gas Leaks, Their Management by a Large Gas Company,
W. R. Addicks, A. G. L. J., LXVI-12-438
Discussion, N. E. Asso. of Gas Engineers, A. G. L. J., LXVI-12-440
- Greenal's and Heaton's Improved Gas Meter, J. G. L., LXIX-1767-653
- Street Main Book-keeping, George F. Summers, A. G. L. J., LXVI-13-481
- The Early History of Cast Iron Pipe, Jesse Garrett, (Abstract),
P. A., XV-10-210; A. G. L. J., LXVI-13-483
- Facts and Figures from the Annual Report of the Massachusetts Gas Inspector,
A. G. L. J., LXVI-14-522
- Detection of Leaks in Gas Mains, *Journal of Gas Lighting*,
A. G. L. J., LXVI-17-639; J. G. L., LXIX-1769-773
- The Flow of Gas or Steam Through Pipes, Arthur J. Martin,
Eng. Lon., Mar. 19, 1897; A. G. L. J., LXVI-15-558
- About Piping, *American Machinist*, P. A., XV-8-163
- The Destruction of Iron Pipes by the Carbonic Acid Dissolved in Water,
R. Petit, (Extract), J. G. L., LXIX-1771-886
- Protective Bushing and Holder for Rubber Gas Bags, Patent Specifications,
A. G. L. J., LXVI-17-643
- Cast Iron Steam Pipes, *Locomotive*, A. G. L. J., LXVI-17-647
- Locating, Determining, and Laying of Street Mains and the Distribution of Gas, J. P. Gill,
A. G. L. J., LXVI-18-678; 19-718; 20-758; 21-798; 22-871; 23-917;
24-962; 25-1000; 26-1024;
G. W., XXVI-670-865; 672-941; 673-98; XXVII-678-97
- Automatic Gas Station Governors, Henry O'Connor,
G. W. XXVI-668-785; J. G. L., LXIX-1773-988
Discussion, Society of Engineers, J. G. L., LXIX-1774-1049
- Notes on Pipe Founding, S. Groves, (Abstract), A. M. I. W., LX-22-766
- Leakage, E. H. Jenkins, P. A., XV-12-270; A. G. L. J., LXVI-24-950
Discussion, Western Association,
P. A., XV-12-274; A. G. L. J., LXVI-24-954
- The Automatic Regulation of Pressure in the Distributing Mains,
Wm. R. Chester, G. E. M. Sup., June 1897-29; G. W., XXVI-674-1049;
J. G. L., LXX-1782-26; A. G. L. J., LXVII-4-122
- Gas Distribution in Relation to Modern Municipal Development,
Thomas Canning, A. G. L. J., LXVII-3-87; J. G. L., LXX-1783-102;
G. E. M. Sup., June 1897-38; G. W., XXVI-674-1064

- Damaging Effects of Electrolysis to Water Mains in Salt Lake City,
F. C. Kelsey, W. & G. R. VII-12-17; VIII-1-22
- An Isolating Apparatus for Mains under Test, M. Bürgkly,
J. G. L., LXX-1784-163
- Giroud and Sappey's Coin Freed Meter with One or More Tills,
J. G. L., LXX-1785-216
- The French Lead Joint Remover,
A. G. L. J., LXVII-6-206
- Electrolysis in the Distribution System, *Water and Gas Review*,
W. & G. R., VIII-2-14
- Prepayment Meters, T. Wilson,
P. A., XV-17-385; A. G. L. J., LXVII-8-292;
J. G. L., LXX-1787-320
- Gas Distribution, W. H. Snow, (Extract), G. W., XXVII-684-323
- The Prevention of Naphthalene Obstructions. *Journal of Gas Lighting*,
J. G. L., LXX-1791-530
- Strengthening Cast Iron Pipes, G. E. M., XIV-256-21
- Suggested Examinations in Gas Distribution, "Fitter,"
J. G. L., LXX-1794-688

LIGHTING.

CONSUMPTION OF GAS AND APPLIANCES THEREFOR.

- Gas Lighting by Incandescence, *Engineering, London*,
A. G. L. J., LXV-14-523; 17-646
- Street Lighting as in Paris, Interesting Experiment at Leicester,
Gas World, G. W., XXV-638-486; E. M., XII-3-836
- New Gas Mantle, J. B. Levy's Patent,
G. E. M., XIII-247-74; A. M. I. W., LIX-17-589
- The Bandsept Burner, M. Broca, A. M. I. W., LIX-17-589
- Efficiency of the London Argand at Different Rates of Gas Consumption,
Lewis T. Wright, G. E. M., XIII-245-34
- The Welsbach Patents in Germany, Decision of the Supreme Court,
W. & G. R., VII-4-18
- Cause of Luminesity in Incandescent Mantles, Dr. C. Killing,
A. G. L. J., LXV-24-934; G. W., XXV-644-707
- The Influence of Foreign Oxides on the Lighting Power of Thorium
Mantles, G. B. Drossbach, (Excerpt), J. G. L., LXVIII-1750-1018
- The Incandescent Gas Light Company, v. The Meteor Incandescent
Lighting Company, Limited,
G. W., XXV-645-748; J. G. L., LXVIII-1750-1019
- The Use of Gas for Domestic Lighting, Vivian B. Lewes,
J. G. L., LXVIII-1751-1068; 1752-1124; 1753-1178;
G. W., XXV-645-739; 646-790; 647-825;
P. A., XIV-23-533; 24-551; XV-1-4;
W. & G. R., VII-6-17; 7-18; 8-18
- Gas Lighting by Incandescence, Serial, 1st Part. Eng. Lon. Sept. 4, 1896
- The Coming Light, *L'Illustration*, S. A. S., Sept. 22, 1896;
P. A., XIV-22-525

- Niagara Gas Burner, *Heating and Ventilation*, H. & V., VI-11-23
- The Net Cost of Different Modes of Lighting, Ritchie & Co.,
J. G. L., LXVIII-1751-1075
- The Fundamental Principles of Incandescent Lighting,
C. Killing, (Abbreviated Trans.), J. G. L., LXVIII-1752-1128
- An Ultra-Incandescent Electric Lamp, *Journal de l'Electricité*,
G. W., XXV-647-823
- Some Experiments in Interior Illuminations, Reflected Light,
C. H. Page, Jr., A. G. L. J., LXV-20-762; P. A., XIV-21-494;
G. W., XXV-647-833
- Alex. C. Humphreys, A. G. L. J., LXV-20-763; P. A., XV-1-12
- Prof. Lewes on the Illuminating Power of Various Burners,
L. de Fonblanque, J. G. L., LXVIII-1753-1188
- Best Forms of Illumination, Vivian B. Lewes, (Extract),
A. M. I. W., LIX-25-877
- Berlin Tests of Holophanes, Light at Different Angles,
H. Drehschmidt, (Extract), J. G. L., LXIX-1759-181;
G. W., XXV-648-861; P. A., XV-1-17
- Fuel Gas and Incandescent Gas Lighting, *Water and Gas Review*,
W. & G. R., VII-6-23
- The Lights of New York, *The Sun*, P. A., XV-1-15
- Primitive Lighting Appliances, *Journal für Gasbeleuchtung*,
P. A., XV-3-56; G. W., XXVI-650-18
- Public Lighting by the Incandescent Gas System at Ramsgate, Report by
W. A. Valon, J. G. L., LXIX-1756-30
- Street Lighting of Paris and London, C. H. T. Collis,
A. G. L. J., LXVI-2-44
- An Improvement in Incandescent Lighting,
G. W., XXVI-654-170; J. G. L., LXIX-1757-77
- A Patent for a New Method for the Production of Incandescent Gas Mantles,
P. A., XV-2-41
- Gas Control from Meter to Burner, D. Macfie,
G. W., XXVI-654-167; J. G. L., LXIX-1758-127
- The Influence of Foreign Metal Oxides upon the Illuminating Power of
Thorium Mantles, G. P. Drossbach, A. M. I. W., LX-4-123
- Cleaning Incandescent Burners, Julius Moeller, G. W., XXVI-653-124
- Light House Illumination, C. S. DuRich Preller, P. A., XIV-19-427
- Gas vs. Electricity in England, P. A., XIV-19-428
- Experimental Tests of the Welsbach Light, P. A., XIV-19-431
- Something About Lamps, *Progressive Age*, P. A., XIV-21-471
- The Vulcan Curling Iron Heater, A. G. L. J., LXVI-5-168
- The Auer Incandescent Light Manufacturing Company, Limited,
vs. William P. O'Brien, P. A., XV-3-53
- Visible and Invisible Light, Silvanus P. Thompson, (Abstract),
P. A., XV-3-58
- Lighting and Extinguishing Gas by Electricity,
Journal of Gas Lighting, J. G. L., LXIX-1760-231

- A Public Lighting Question at Clitheroe, *Journal of Gas Lighting*,
J. G. L., LXIX-1760-245
- The Development of Light from Gas Flames, Vivian B. Lewes,
J. G. L., LXIX-1763-406; G. W., XXVI-655-203
W. & G. R., VII-10-20; P. A., Sup. Mar. 1897-p. 15.
- Distribution and Diffusion of Light, E. L. Elliott,
A. G. L. J., LXVI-6-207
- A New Stiffening Fluid for Welsbach Mantles, A. M. I. W., LX-7-229
- The Welsbach System of Street Lighting, P. A., XV-4-85
- Chimneys for Incandescent Gas Lighting, *Gas World*, P. A., XV-4-86
- A Key to Street Lighting Effects, *Journal of Gas Lighting*,
J. G. L., LXIX-1762-341
- Artificial Illumination, G. P. Lewis,
P. A., XV-6-121; G. W., XXVI-657-292; J. G. L., LXIX-1762-348
- Public Lighting by the Welsbach System in Paris, J. G. L., LXIX-1762-350
- Automatic Gas Lighting and Extinction, A Practical Test,
Journal des Usines à Gaz, 1897, No. 3-34-36
Summarized, G. W., XXVI-657-291
- Committal Proceedings against Infringers of the Welsbach Patents,
G. W., XXVI-657-301
- The Denayrouze Burner in England, *Journal of Gas Lighting*,
J. G. L., LXIX-1763-405
- The Utilization of Coke Oven Gas for Illuminating Purposes,
American Manufacturer, A. M. I. W., LX-9-302
- Electrolytic Manufacture of Incandescent Mantles, J. G. L., LXIX-1765-527
- Welsbach Lighting in Paris, M. Maréchal,
P. A., XV-6-123; 7-148; G. W., XXVI-660-413
- The Cause of Luminosity of Hydrocarbon Flames, Wilfred Irwin,
(Abstract), G. W., XXVI-660-419
- Holophanes with the Welsbach Light, *Progressive Age*, P. A., XV-6-117
- Lighting by Acetylene, J. G. L., LXIX-1766-585
- The Source of Light in Flames, Arthur Smithells. (Abstract),
J. G. L., LXIX-1767-652; G. W., XXVI-661-452;
A. G. L. J., LXVI-14-523
- Schmidt's Electric Gas Lighting Device, Patent Specifications,
A. G. L. J., LXVI-12-447
- The Welsbach Incandescent Light, *American Manufacturer*,
A. M. I. W., LX-13-447
- Before and After, *Gas World*, G. W., XXVI-662-496
- Incandescent Gas Light and Sight, *Lancet*, A. G. L. J., LXVI-13-485
- Artificial Light: Modern Methods Compared: Electric, Incandescent, Wels-
bach, Acetylene, D. S. Jacobus, P. A., XV-7-137; 9-182; 10-203
- Igniting Gas in Incandescent Lamps, *Journal of Gas Lighting*,
A. G. L. J., LXVI-14-530
- Petroleum Welsbachs, "*Le Gaz*," 1897, No. 9, G. W., XXVI-664-577
- Incandescent Gas Lighting, C. Killing, P. A., XV-8-158

- Lighting and Extinction of Gas Burners from Distant Points by Electricity,
P. A., XV-8-159
- Ingenious System of Lighting Gas Jets, P. A., XV-8-163
- The Intimate Mixture of Gas and Air for Incandescent Gas Burners, Patent
Specifications, A. G. L. J., LXVI-17-648
- Railway Carriage Lighting, Pintsch Gas, H. Gordes,
J. G. L., LXIX-1777-1247; G. W., XXVI-667-69
- The Luminosity of Flame, Prof. Smithells,
G. E. M., XIII-254-221, 255-239; J. G. L., LXIX-1774-1045;
G. W., XXVI-668-749
- Incandescent Gas Burners for Public Lighting, Contradictory Reports,
Summary of Thomas H. Nesbitt's Report, G. W., XXVI-670-868
- The Theory of Incandescent Gas Lighting, Dr. Moscheles,
(Abstract Trans.), J. G. L., LXIX-1777-1237
- Incandescent Gas Lighting in Infirmarys, J. G. L., LXIX-1777-1256
- Incandescent Gas Light Company, Limited, Annual Meeting,
J. G. L., LXIX-1779-1369; G. W., XXVI-673-986
- The Welsbach Incandescent Gas Light for Utility and Economy in Street
Lighting, H. Wilkiemeyer,
P. A., XV-12-276; A. G. L. J., LXVI-24-957
- Discussion, Western Association,
P. A., XV-12-277; A. G. L. J., LXVI-24-958
- The Gas in Your House, D. E., Apr. 1897
- The Economical Limit of Lighting Appliances, *Journal of Gas Lighting*,
J. G. L., LXIX-1779-1351
- The Cause of Luminosity of Hydrocarbon Flames, Wilfrid Irwin,
J. G. L., LXIX-1779-1357
- The Theory of the Atmospheric Burner and its Influence Upon Incandescent
Gas Lighting, Vivian B. Lewes,
A. G. L. J., LXVII-2-42; P. A., XV-13-298;
W. & G. R., VIII-1-17; G. E. M. Sup., June 1897-18;
J. G. L., LXIX-1780-1412; G. W., XXVI-674-1034
- Improvements in Incandescent Gas Lighting, *Gas World*,
A. M. I. W., LX-26-913
- Automatic Gas Kindler, D. Drehschmidt, G. W., XXVII-677-52
- The Improved Denayrouze Burner, *Journal of Gas Lighting*,
J. G. L., LXX-1782-38
- Incandescent Gas Lighting at Angers, M. Bigeard, J. G. L., LXX-1784-163
- The Incandescent Gas Light as an Outdoor Illuminant, L. de Fonblanque,
J. G. L., LXX-1784-168; G. W., XXVII-679-129;
W. & G. R., VIII-2-22
- The Consumption of Gas by Incandescent Burners, J. G. L., LXX-1784-176
- The Lighting of the Thames Embankment, Electric Light & Incandescent
Gas Burners, *Journal of Gas Lighting*, J. G. L., LXX-1784-177
- More Litigation Over Incandescent Gas Patents, G. W., XXVII-679-131
- The Improved Denayrouze Burner, *Journal of Gas Lighting*,
A. G. L. J., LXVII-5-172

- The Design of Electric Light and Gas Fittings, *Journal of Gas Lighting*,
J. G. L., LXX-1785-212
- The Sunlight Incandescent Gas Lamp Company, Limited, v. The Incandescent
Gas Light Company, Limited, The Rawson Patent for Toughening
Mantles, G. E. M., XIII-255-233; P. A., XV-17-391;
G. W., XXVII-680-176; J. G. L., LXX-1785-221
- Monazite, H. B. Nitze, P. A., XV-16-364
- The Principal Consideration Which Governs the Cost of Incandescent Gas
Lighting, Mr. Löhren, (Extract), P. A., XV-16-369
- A Method of Using Welsbach Burners without Chimnies, M. Andre Coze,
(Summary), A. G. L. J., LXVII-6-214
- Controlling Valve for Gas Burners, A. G. L. J., LXVII-6-215
- The Bandsept Burner, A. Bandsept, (Abstract),
P. A., XV-17-387; G. E. M., XIII-255-242
- The Welsbach Light, G. I. Kinney, A. G. L. J., LXVII-7-245
- Incandescent Gas and Electric Lighting, A Comparison,
W. W. Gillespie, A. G. L. J., LXVII-7-246
- Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-7-247
- Lighting by Reflection, J. G. L., LXX-1789-431
- The Expense of Handling Welsbach Lights, P. A., XV-17-391
- Thorium Nitrate Mantles, L. Wenghoffer, (Extract),
A. M. I. W., LXI-11-375
- Acetylene Gas for Public Lighting in Hungary, A. M. I. W., LXI-11-375
- Electricity v. Gas for Lighthouse Illumination, A. G. L. J., LXVII-10-374
- The March of Progress, *Progressive Age*, P. A., XV-18-396
- Development of an Atmospheric Burner, A. Bandsept, P. A., XV-18-401
- The Lighting of Railway Cars, H. Gordes, P. A., XV-18-412
- A Folding Ferrule for Incandescent Mantles, P. A., XV-18-419
- Street Lighting by Incandescent Gas Burners, A New Lamp, C. R. Bellamy,
J. G. L., LXX-1791-534; G. W., XXVII-686-395;
A. G. L. J., LXVII-13-484
- Gas as an Illuminant, *Water and Gas Review*, W. & G. R., VIII-3-22
- Modern Methods of Artificial Lighting Compared, D. S. Jacobus,
G. W., XXVII-687-433
- Transmission of Light, Frank L. Woodward, (Extract),
J. G. L., LXX-1793-630

HEATING.

CONSUMPTION OF GAS AND APPLIANCES THEREFOR.

- The Heating of Public Buildings by Gas Stoves, *Journal of Gas Lighting*,
J. G. L., LXVIII-1743-646
- The Cost of Heating Rooms by Gas, Thomas Fletcher,
G. W., XXV-641-590; J. G. L., LXVIII-1746-796
- (Extract), A. M. I. W., LX-7-229
- Economical Gas Heating, H. L. Gautt, A. M. I. W., LIX-18-625

- Incandescent Fire Mantel, T. E. Pye,
A. G. L. J., LXV-20-766; G. W., XXV-641-594
- The Bunsen Flame, W. H. Birchmore, A. G. L. J., LXV-18-690
- Fletcher, Russell & C's Improvements in Gas Heating Appliances,
Journal of Gas Lighting, J. G. L., LXVIII-1748-907
- Trials of Gas Stoves, Prof. A. von Ihering, (Summary),
A. G. L. J., LXVI-2-43; J. G. L., LXVIII-1749-968
- Gas Stoves, D. Decker, G. W., XXV-644-713
- Automatic Regulation of Temperature of Gas Fires, G. E. M., XIII-246-48
- Finlay Flameless Gas Stove, W. & G. R., VII-5-21
- The Andre System of Gas Heated Ovens, P. Chevillard,
A. G. L. J., LXV-24-928
- Introducing Gas Stoves, C. H. Nettleton,
P. A., XIV-21-478; G. W., XXV-648-861
- German Regenerative Stoves, *Heating and Ventilation*, H. & V., VI-12-9
- Heating School Buildings by Gas, Hygienic Institute Report,
P. A., XV-2-34
- An Improved Bunsen Burner, G. E. M., XIII-248-91; P. A., XIV-19-431
- Comparative Test of the Calorific Powers of Wilkinson Carburetted Water Gas
and Lowe Carburetted Water Gas with the Junker Calorimeter, Martin
Shepard, Rudolph Bruckner, and John Schimmel, Jr.,
P. A., XIV-22-516; 23-542
- Gas Stoves, Their Introduction, Construction and Use, T. C. Jones,
P. A., XV-4-71; A. G. L. J., LXVI-7-239
- Discussion, Ohio Gas Light Association,
A. G. L. J., LXVI-8-280; P. A., XV-4-72
- Gas Fires and Gas Stoves, W. Grafton, S. P., Dec. 1, 1896
- The Rawson Patent for Stiffening Mantles, G. W., XXVI-659-383
- Economics in Gas Firing, August Dauber, A. M. I. W., LX-11-374
- A Field for Cultivation, *Gas World*, G. W., XXVI-663-537
- The Commercial Uses of Coal Gas, Thos. Fletcher,
P. A., XV-9-682; A. G. L. J., LXVI-16-598; 18-682; 22-872;
23-919; 26-1040; G. W., XXVI-663-539; 665-613; 669-827;
670-864; 673-977.
- Street Lighting by Incandescent Burners, J. G. L., LXIX-1770-827
- Economy in Gas Fuel, Thomas Fletcher, (Abstract),
A. M. I. W., LX-17-590
- Use of Coal Gas in Muffle Furnaces, Thomas Fletcher,
A. M. I. W., LX-22-77
- Gas Firing, A Gas Burning Water Heater or Steam Boiler, Illustrated Des-
cription of Invention of John S. Coe, A. M., Mar. 18, 1897
- The Coal vs. Gas Range, From the Annual Report of T. J. Hogan, Secretary
of the National Association of Stove Manufacturers, P. A., XV-11-219
- Supplementary Gas Heater for Domestic Water Supplies,
Journal of Gas Lighting, J. G. L., LXIX-1778-1297
- On Cooking by the Aid of Gas, and the Ventilation of Kitchens, William Sugg,
J. G. L., LXIX-1781-1482; G. E. M. Sup., June 1897-14;
G. W., XXVI-674-1027; A. C. L. J., LXVII-5-162

- The Theory of the Atmospheric Burner, and Its Influence upon Incandescent Gas Lighting, Vivian B. Lewes, G. E. M. Sup., June 1897-18
- Gas Stoves and Coal Fires, G. A. S., J. G. L., LXX-1783-113
- Greenhouse Heating by Gas, M. Garnier, J. G. L., LXX-1788-373
- Gas as a Fuel, F. Foveaux, A. G. L. J., LXVII-9-323
- Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-9-325
- Increasing Fuel Gas Consumption, A. M. I. W., LXI-11-375
- Development of an Atmospheric Burner, A. Bandsept, P. A., XV-18-401
- The Clarke Apparatus for Heating Water, Patent Specifications, A. G. L. J., LXVII-13-486

POWER.

CONSUMPTION OF GAS AND APPLIANCES THEREFOR.

- Gas Motor Street Car, *The Engineer, London*, A. M. I. W., LIX-14-476
- Gas Engine Possibilities, George S. Strong, G. E. M., XIII-246-54; A. M. I. W., LIX-16-553
- Gas vs. Electricity for Power Transmission, Nelson W. Perry, E. M., XII-1-11; 2-261; G. W., XXV-639-527; 644-709;
- Steam Engine and Gas Motor, A. M. I. W., LIX-17-589
- Gas Power on European Street Railways, A. M. I. W., LIX-17-589
- Efficiency of Gas Engines, Herr Körting, G. W., XXV-640-560
- The Rey Gas Engine, *Gas World*, A. G. L. J., LXV-17-647
- The Borsig Four-Cycle Gas Engine, *Engineering*, A. G. L. J., LXV-77-648
- The Simplex Gas Engine, *American Manufacturer*, A. M. I. W., LIX-18-625
- Gas Engines for Auto-Motors, D. Salomons, G. W., XXV-641-601
- Late Gas Engine Patents, *Water and Gas Review*, W. & G. R., VII-4-23; 5-23; 6-23; 7-23;
- Thwaites Motor Car Producers, Eng., Lond., Aug. 28, 1896
- Use of Blast Furnace Gas in Gas Engines, A. M. I. W., LIX-19-663
- Combustion in Gas Engines, F. Haber and A. Weber, (Extracts). P. A., XIV-24-558; A. G. L. J., LXV-22-853; G. W., XXV-643-675
- British Gas Traction Company, Limited, Statutory Meeting, J. G. L., LXVII-1749-975
- Gas as a Motive Power for Vessels, *American Gas Light Journal*, G. E. M., XIII-246-54
- Gas vs. Electricity Direct from Coal, D. M. Dunning, W. & G. R., VII-5-19; 6-15; 7-15
- A Gas Power Electric Light Station, *Engineer*, Eng., Lond., Nov., 1896; (Extract), J. G. L., LXVIII-1754-1233
- Motive Power for Generating Electricity, *Journal of Gas Lighting*, J. G. L., LXIX-1756-17
- Experiments on a 160 I. H. P. Gas Engine, Driven with Producer Gas, at the Bale Water Works, Switzerland, 1896, Summarized Translation by Bryan Donkin, A. G. L. J., LXVI-4-123; J. G. L., LXIX-1756-20

- Four-Cycle Gas Engine, A. M. I. W., LX-2-43
- Gas Tramways, A. Lavezzari, P. A., XV-2-29
- Gas Engines, *American Electrician*, P. A., XV-2-35
- The Determination of the Cost of Electric Lighting by Gas Engine,
J. L. Chrystie and S. A. Hasbrouck, A. G. L. J., LXVI-4-125
- Gas and Oil Engines, *Cassiers' Magazine*, C. M., XI-2-164
- The Progress of Gas Engines, *Progressive Age*, P. A., XIV-20-438
- The "New" Gas Engine, *Progressive Age*, P. A., XIV-20-439
- The Use of Gas Engines, A Chat with the Power User, F. N. Morton,
P. A., XIV-20-441
- A Modern Motor, *Progressive Age*, P. A., XIV-20-442
- Gas Engines in the Casino of Royan, *Progressive Age*, P. A., XIV-20-446
- Gas Engines for Isolated Electric Plants, P. A., XIV-20-446
- Gas vs. Steam Engines for Hoisting, Joseph Parry, (Abstract),
P. A., XIV-20-447
- Gas Engines in the Belfast Electric Lighting Plant, Victor A. H. McCowen,
(Abstract), P. A., XIV-20-450
- Recent Developments in Gas Engines, Dugald Clerk, P. A., XIV-20-451
- Gas Engines in Central Electrical Stations, R. Knocke, P. A., XIV-20-452
- How to Overhaul a Gas Engine, J. W. Seers, P. A., XIV-20-454
- Gas Cylinder Explosions, P. A., XIV-20-455
- Test of an Isolated Electric Lighting Plant Run by Gas Engine,
S. A. Beyland, P. A., XIV-20-456
- The Gas Engine, N. W. Perry, (Extract), P. A., XIV-20-457
- A Gas-Driven Barge, *Progressive Age*, P. A., XIV-20-458
- The Fairbanks, Morse & Co., Gas Engine, P. A., XIV-20-460
- Descriptive Article of the Gas Engine Yacht "Nameless," P. A., XIV-20-462
- The Gas Engine, Part XXIV, P. A., XIV-21-499
- The Large Gas Engine, Its Present Development and Forecast of Its Future
for Electrical Purposes, E. F. Lloyd,
P. A., XV-5-92; A. G. L. J., LXVI-7-242
- Discussion, Ohio Gas Light Association,
P. A., XV-5-93; A. G. L. J., LXVI-8-284
- The Future of the Gas Engine in America, *Progressive Age*, P. A., XV-4-66
- Gas Power Locomotives, A. M. I. W., LX-8-265
- The Gas Locomotive, A. M. I. W., LX-8-265
- Internal Combustion Engines, C. W. Hart and C. H. Parr,
Wis. Eng., Oct. 1896
- Electrically Controlled Gas Motor, I. T. R., Dec. 1896
- A Gas Fire Engine, *New York Journal*, P. A., XV-5-91
- Dowson Gas, *American Manufacturer*, A. M. I. W., LX-10-337
- Gas Engines in Flour Mills, *Engineering*, A. G. L. J., LXVI-11-410
- The Large Gas Engine, *Progressive Age*, P. A., XV-6-113
- Gas Engines, V. P. Van Horne, P. A., XV-6-116
- The Gas Engine Industry, *Electricity*, P. A., XV-6-126
- Gas Traction on Street Railways, M. A. Lavezzari, (Extracts).
A. M. I. W., LX-14-482; A. G. L. J., LXVI-13-485

- Gas and Oil Engines, Thomas L. Wilkinson, M. I. & R., Dec. 31, 1896
 Mr. Lloyd Points Out the Difference between Fair and Unfair Criticism,
 P. A., XV-8-161; A. G. L. J., LXVI-14-527
- Gas Engines for Mining, *Colliery Engineer*, A. M. I. W., LX-15-518
 Theories about Large Gas Engines, Dedicated to Mr. Lloyd,
Progressive Age, P. A., XV-8-155
- The Gas Engine Industry, Electricity, (Editorial), P. A., XV-8-162; 9-181
 Sydney A. Reeve, P. A., XV-9-192
- Increasing the Efficiency of Gas Engines, P. A., XV-8-175
 A New Thermic Engine, as described by M. Delsoe, P. A., XV-8-175
- Gas for Auto-Motors, W. Worby Beaumont, (Abstract),
 A. M. I. W., LX-16-555
- Gas and Gasoline Engines, M. T. Monoque, Sci., Mar. 1, 1897
 Experiments upon the Combustion of Illuminating Gas in the Cylinders of
 Gas Engines, Fritz Haber and A. Weber, P. A., XV-9-184
- A New Gas Engine Cycle, *Electrician*,
 J. G. L., LXIX-1773-991; P. A., XV-11-251
- Can the Gas Engine Builders be Trusted to Manage Their Business?
 P. A., XV-10-201
- Gas Engine Requirements, Sydney A. Reeve, P. A., XV-10-208
- A Practical Illustration of the Working of a Large Gas Engine,
 Ernest F. Lloyd, A. G. L. J., LXVI-20-767
- New Era Gas and Gasoline Engine, *American Manufacturer*,
 A. M. I. W., LX-21-719
- Gas for Power Purposes, J. Emerson Dowson,
 J. G. L., LXIX-1777-1244; G. W., XXVI-671-905;
 W. & G. R., VII-12-29; A. G. L. J., LXVI-25-1003;
 A. M. I. W., LX-25-877
- Late Gas Engine Patents, W. & G. R., VII-11-23
- Gas Engines, Dr. Petreano, *Zeitschr d. Ver. deutschen Ing.*, Feb. 6, 1897
- Recent Developments in Gas Engines, Dugald Clerk, E. N., Apr. 1, 1897
- Gas and Gasoline Motors, *Revue Industrielle*, S. A. S., Apr. 3, 1897
- Gasoline Motor, W. O. Amsler, S. J. E., Mar. 1897
- The Transmission of Power by Electricity, Water and Other Agents,
 W. H. Preece and Others, J. G. L., LXIX-1777-1239
- The Lancaster Gas Engine Starter Patent, J. G. L., LXIX-1778-1305
- The Large Gas Engine, E. F. Lloyd, C. M., XII-2-122
- Popplewell on Heat Engines, J. G. L., LXIX-1780-1418
- Compressed Gas Motor Cars, M. A. Lavezzari,
 P. A., XV-15-343; A. M. I. W., LXI-2-49; G. E. M., XIII-253-201
- Balance in Gas Engines, D. Salomons, (Extract), W. & G. R., VII-12-29
- Late Gas Engine Patents, W. & G. R., VII-12-31; VIII-2-23
- A Novel Gas Engine Pumping Plant, *Progressive Age*, P. A., XV-13-304
- The Gas Engine Industry in the United States, (Editorial),
Scientific American, P. A., XV-13-305
- Gas Engines, W. F. Kelly,
 S. R. R., June 15, 1897; A. G. L. J., LXVII-1-11

- Improvement in Gas Engines, Dugald Clerk, (Extract), A. M. I. W., LXI-2-49
 The Gas Railroad, Frederick Egner, A. G. L. J., LXVII-2-47
 Gas Motors for Tramways, E. M., XIII-4-633
 Gas Engine Requirements, Sidney A. Reeve, Elect., May 12, 1897
 A New Motive Power, Method Found for Using the Energy of Carbonic
 Acid Gas, Lewis B. White, W. & G. R., VIII-2-17
 Combustion of Gas When Used in Gas Engines, F. Haber and A. Weber,
 (Summary), G. E. M., XIII-255-242
 French Practice with Large Gas Engines,
 W. & G. R., VIII-3-21; J. G. L., LXX-1791-527
 A Table of Gas Engine Patents, J. G. L., LXX-1792-576
 A Lesson Afforded by the Failure of a Gas Engine,
 A. G. L. J. LXVII-13-486
 The Westinghouse Gas Engine, J. G. L., LXX-1794-678

RESIDUALS,

INCLUDING MATTERS RELATING TO ALL PRODUCTS OF A GAS UNDERTAKING
 OTHER THAN GAS.

- Evaporative Powers of Coke and Coal, A. Weber, A. M. I. W., LIX-14-480
 Desulphurization of Ammoniacal Liquor, M. Chevalet, G. W., XXV-637-448
 Formation of Cyanogen from Ammonia, E. Bergmann,
 A. G. L. J., LXV-16-603
 The Velna Process for the Manufacturer of Briquettes from Waste Coal and
 Mineral Tar, *L'Industrie*,
 A. G. L. J., LXV-21-815; A. M. I. W., LIX-20-696
 The Residuals Market, W. E. Price,
 J. G. L., LXVIII-1749-958; G. W., XXV-643-666
 Gas Lime for Foul Poultry Runs, *Journal of Gas Lighting*,
 J. G. L., LXVIII-1749-957
 Separation of Water Gas Tar, Alten S. Miller,
 J. G. L., LXVIII-1750-1017; A. G. L. J., LXV-22-846;
 G. W., XXV-644-707
 The Manufacture of Compressed Fuel in the United States, John R. Wagner,
 C. M., II-1-23
 Notes on Sulphate of Ammonia, T. N. Ritson,
 A. M. I. W., LX-2-50; G. W., XXV-646-786;
 J. G. L., LXVIII-1751-1073
 Discussion, Manchester Dist. Asso. of Gas Engineers,
 J. G. L., LXVIII-1752-1123
 The Analysis of Coke, George C. Davis, A. G. L. J., LXV-24-933
 The Position of Sulphate of Ammonia, *Journal of Gas Lighting*,
 J. G. L., LXVIII-1753-1183
 The Filtration of Sewage through Coke, J. G. L., LXIX-1757-75
 The Manufacture of Sulphate of Ammonia, C. Tanner, Jr.,
 G. W., XXVI-652-95

- Sulphate of Ammonia Market in 1896, Bradbury and Hirsch,
J. G. L., LXIX-1759-193; G. W., XXVI-653-128
- Sulphate of Ammonia, H. H. Cousins,
J. G. L., LXIX-1759-180; 1760-232; 1761-288
- Transformation of Sulphocyanides into Alkaline Ferrocyanides, Produced
during the Manufacture of Illuminating Gas, Andre Dubose,
A. G. L. J., LXVI-6-203; A. M. I. W., LX-5-158
- Use of Sulphate of Ammonia on Crops, *Gas Engineers' Magazine*,
G. E. M., XIII-248-95
- The Tar Plant at Widnes, *Gas World*, P. A., XIV-19-429
- Why Coal Tar Products are "Made in Germany," *Journal of Gas Lighting*,
J. G. L., LXIX-1761-283
- Sulphate of Ammonia, F. J. R. Carulla, G. W., XXVI-656-242
Communication, F. J. R. Carulla, G. W., XXVI-659-368
- Coal Tar Prices and Congress, *American Gas Light Journal*,
A. G. L. J., LXVI-7-238
- The Suppression of Smoke by the Use of Coke, *Progressive Age*,
P. A., XV-4-78
- The Commercial Position of Sulphate of Ammonia, J. G. L., LXIX-1762-350
- The Recovery of Cyanogen from Coke Oven Gas, *American Manufacturer*,
A. M. I. W., LX-9-303
- Extraction of Ammonia from Spent Oxide, Carl H. Graf,
A. G. L. J., LXVI-9-325; 14-518
Discussion, N. E. Asso. of Gas Engineers, A. G. L. J., LXVI-9-327
Communication from Mr. Graf, A. G. L. J., LXVI-16-608
- Coke Breeze for Sewage Filtration, S. F. Binford and T. Reader Smith,
(Extracts), J. G. L., LXIX-1764-462
- Does the Manufacture of Sulphate of Ammonia Pay in Small Works?
J. Wilkinson, A. G. L. J., LXVI-14-525; G. W., XXVI-659-374;
J. G. L., LXII-1764-473
- Recovering Cyanides from the Waste Products of Gas Works, Recent
English Letters Patent, A. G. L. J., LXVI-11-407
- The Use of Breeze as Fuel, J. Haymann, J. G. L., LXIX-1767-654
- The Examination of Commercial Liquid Ammonia, Dr. Bunte and
Dr. Eitner's Method, J. G. L., LXIX-1770-833
- Using Spent Gas Lime for Mortar, J. G. L., LXIX-1770-845
- The Nitrogenous Bye-Products of Gas Works, *Engineer*,
J. G. L., LXIX-1771-895
- The Gas Tar Distillers' Association, Interesting Chancery Action,
G. W., XXVI-667-698
- Notes on Cyanogen as a Gasworks Residual, G. P. Lewis,
P. A., XV-11-247; J. G. L., LXIX-1774-1049;
G. W., XXVI-668-753
Discussion, Institution of Gas Engineers,
J. G. L., LXIX-1774-1053; G. W., XXVI-668-757
- Anhydrous Ammonia for Ice Machines, Henry Faunot,
C. M., XII-1-48; A. G. L. J., LXVI-19-728

- Value of Spent Oxide, Dr. Auerbach, (Summary),
A. M. I. W., LX-20-698; J. G. L., LXIX-1774-1056
- Cyanogen in Coal Gas, Communications, Edward A. Harman,
J. G. L., LXIX-1775-1139; G. W., XXVI-669-824; 671-900;
G. P. Lewis, G. W., XXVI-670-862
- The Agricultural Value of Sulphate of Ammonia from Blast Furnaces,
F. J. R. Carulla,
A. G. L. J., LXVI-26-1043; J. G. L., LXIX-1775-1134;
G. W., XXVI-669-831
- An Oil Tar Separator and Its Results, J. R. Lynn,
A. G. L. J., LXVI-22-857; P. A., XV-11-233
Summary, G. W., XXVI-675-1097
Discussion, Western Association,
A. G. L. J., LXVI-22-859; P. A., XV-11-235
- What Buyers of Spent Oxide Want, Dr. Auerbach,
A. G. L. J., LXVI-26-1035; G. W., XXVI-672-944
- Alkali Works Regulation Acts, Inspector's Annual Report,
J. G. L., LXIX-1778-1306; 1779-1367; G. W., XXVI-672-945;
- A New Source of Sulphate of Ammonia Manure, Herbert Jones,
(Abstract), J. G. L., LXIX-1778-1294
- The New Change Valve for the Sulphate Plant at the Richmond Gas Works,
Journal of Gas Lighting, J. G. L., LXIX-1778-1296
- Cyanogen Compounds in Coal Gas, Edward A. Harman,
G. E. M., XIII-253-198
- Light Coal Tar Oil as a Germicide, J. G. L., LXIX-1781-1494
- Bye-Products and Adjuncts of the Gas Industry, H. Bunte,
A. M. I. W., LXI-2-49
- Shale Distillation and the Production of Sulphate of Ammonia,
Journal of Gas Lighting, J. G. L., LXX-1782-38
- Carburetted Water Gas for Birkenhead, Report to the Gas Committee,
Vivian B. Lewes, G. E. M., XII-254-217
- A Hint to Our Manufacturers, *New York Tribune*,
A. G. L. J., LXVII-4-130
- Asphalt Examination, H. Endemann, A. G. L. J., LXVII-4-130
- The Future of Sulphate of Ammonia, G. W., XXVII-680-180
- The Combined Action Among Sulphate of Ammonia Manufacturers,
J. G. L., LXX-1786-276
- The Mechanical Stacking of Coke,
A. G. L. J., LXVII-8-282; J. G. L., LXX-1787-316
- The Coal Tar Color Industry in England, J. G. L., LXX-1787-316
- Profits of the German Coal Tar Industry, J. G. L., LXX-1790-476
- Explosion of a Tar Still, with Fatal Results, *Engineering*,
A. G. L. J., LXVII-10-372
- The Sulphate Question in Europe, Col. Wm. Thomas Watkins,
(Extract), P. A., XV-18-408
- How to Popularize Sulphate of Ammonia, G. W., XXVII-686-400

- Bye-Products and Auxiliary Materials, H. Bunte, (Trans.),
A. G. L. J., LXVII-12-444
The Agricultural Value of Sulphate of Ammonia, Comments on F. J. R.
Carulla's Paper, J. G. L., LXX-1792-586
The Sale of Sulphate of Ammonia, Norton H. Humphreys,
J. G. L., LXX-1794-678

CHEMICAL,

INCLUDING TESTING AND ANALYSIS OF MATERIAL AND PRODUCT, AND
GENERAL CHEMICAL NOTES RELATING TO GAS MATTERS.

- The Detection and Estimation of Carbonic Oxide in the Air, Dr. Haldane,
(Abstract), J. G. L., LXVIII-1744-692
Determination of Oxygen by Absorption with Alkaline Pyrogallol Solution,
Frank Clowes, (Extract,) J. G. L., LXVIII-1745-740
A New Elementary Body, *Chemical News*, J. G. L., LXVIII-1746-792
Rapid Measuring Pipette. Edward L. Smith, A. G. L. J., LXV-21-813
Summary of Papers Read at the Chemical Section of the British Association,
Frank Clowes, G. E. M., XIII-246-50
The Analysis of Coke, George C. Davis, A. G. L. J., LXV-24-933
Metallic Carbides, *American Manufacturer*. A. M. I. W., LX-1-17
On Some New Forms of Gas Generators for Laboratories,
Thomas H. Norton, A. G. L. J., LXVI-1-7
On the Behavior of Coal Tar Colors Towards the Process of Digestion,
H. A. Weber, A. G. L. J., LXVI-1-10
The Proximate Constituents of Coal, Report of the British Association
Committee, J. G. L., LXIX-1756-22
Products of Combustion of Coal Gas and Their Influence upon Health,
Ch. Geelmuyden, (Extract from report,) P. A., XV-2-32
Comparative Test of the Calorific Powers of Wilkinson Carburetted Water Gas
and Lowe Carburetted Water Gas with the Junker Calorimeter, Martin
Shepard, Rudolph E. Bruckner and John Schimmel, Jr.,
P. A., XIV-22-516; 23-542
Determination of Sulphur in Coke and Coal, Shtolba, P. A., XIV-24-560
The Composition and Toxic Effects of Certain Gases,
P. A., XV-6-123; J. G. L., LXIX-1761-290
On the Measurement of Sulphurous and Sulphuric Acids in the Products of
Combustion of Illuminating Gases, M. Dennstedt and C. Ahrens,
P. A., XV-4-81
The Decomposition of Hydrocarbons by Heat, F. Haber and H. Oechelhaeuser.
J. G. L., LXIX-1762-349; 1763-409; 1764-476; 1765-528; 1766-589
The Cause of Luminosity of Hydrocarbon Flames, Wilfrid Irwin,
J. G. L., LXIX-1779-1357; G. W. XXVI-660-419
A Technical Analysis of Hydrocarbons, Vapors and Gases in Literature and
Laboratory, W. H. Birchmore,
G. W., XXVI-665-616; 666-661; 667-695;
A. G. L. J., LXVI-12-445; 13-478
Determining the Gas Making Value of Mineral Oils. F. Helfers,
(Abstract Trans.) J. G. L., LXIX-1767-650

- Facts and Figures from the Annual Report of the Massachusetts Gas Inspector, A. G. L. J., LXVI-14-522
- Some Apparatus for the Technical Analytical Laboratory, E. S. Johnson, A. G. L. J., LXVI-16-604
- The Sampling and Analysis of Coke, W. F. Keating, (Abstract,) J. G. L., LXIX-1776-1188
- Apparatus for Technical Gas Analysis, Otto Bleier, (Trans.) J. G. L., LXIX-1776-1189
- Explosion Flames, Harold B. Dixon, (Report of Lecture,) J. G. L., LXIX-1776-1190
- The Recovery of Cyanogen Compounds from Gas, George Beilly, J. G. L., LXIX-1776-1194
G. P. Lewis, J. G. L., LXIX-1778-1302
- Production of Hydrocyanic Acid, Herr Bergmann, (Extract,) A. M. I. W., LX-23-805
- A Volumetric Method of Determining the Amount of Free Sulphur in Spent Oxide of Iron, H. C. Page, J. G. L., LXIX-1779-1354
- Acetylene for Laboratory Use, A. E. Munby, (Extract,) P. A., XV-12-285
- The Theory of the Atmospheric Burner, Vivian B. Lewes, W. & G. R., VIII-1-17; J. G. L., LXIX-1780-1412;
G. W., XXVI-674-1034; P. A., XV-13-298;
A. G. L. J., LXVII-2-42
- The Liquefaction of Fluorine. H. Moissan and J. Dewar, (Abstract,) A. G. L. J., LXVII-4-126
- Estimating Free Nitrogen in Purified Coal Gas, *Progressive Age*, P. A., XV-15-344
- Sodium Ferrocyanide, H. F. Fermor, J. G. L., LXX-1785-213
- The Determination of Sulphur in Spent Oxide, W. Jackson, J. G. L., LXX-1787-327
- Simple Tests of Impurities in Gas, Henry O'Connor, (Extract,) A. G. L. J., LXVII-7-252
- The Estimation of Oxygen in Coal Gas, *Journal of Gas Lighting*, J. G. L., LXX-1788-370
- Description of an Unknown Gas, William Ramsay, (Extract,) J. G. L., LXX-1790-476
- Testing of Vitiated Air for Injurious Gases, A. Mermet, (Extract,) Comptes Rendus, Vol. 124-621 March, 1897, P. A., XV-17-388
- Chemical Processes in the Gas Plant, Dr. Leybold, A. M. I. W., LXI-11-374
- Solution of Solids in Gases, M. P. Villard, G. W., XXVII-685-358
A. G. L. J., LXVII-13-483
- Notes on Lucium, Waldron Shapleigh, P. A., XV-18-416
- New Earths, *Chemical News*, (Extract,) P. A., XV-18-419
- The Separation of Rare Earths, P. A., XV-18-419
- Impurities of the Air in Purifying and Regenerating Houses, H. Drehschmidt, (Summary,) G. W., XXVII-686-400

PHYSICAL,

AND GENERAL TECHNICAL MATTERS RELATING TO LABORATORY PRACTICE
AND RESEARCH BEARING UPON THE GAS INDUSTRY.

- Photometry and the Law of Inverse Squares, Henry Morton,
G. W., XXV-637-448
- Determination of the Calorific Value of Fuels, J. G. L., LXVIII-1743-646
- Photometry according to Palaz, *Journal of Gas Lighting*,
J. G. L., LXVIII-1744-687
- Units in Photometry, *Gas World*, G. W., XXV-639-524
- Mr. W. H. Preece's Photometry, *Journal of Gas Lighting*,
J. G. L., LXVIII-1745-740
- The Origin of Waves of Light, W. Wedding, (Abstract),
A. G. L. J., LXV-21-814; J. G. L., LXVIII-1746-791
- Comparative Test of the Calorific Powers of Wilkinson Carburetted Water Gas
and Lowe Carburetted Water Gas with the Junker Calorimeter, Martin
Shepard, Rudolph E. Buckner, and John Schimmel, Jr.,
S. I., XIII-4-381
- The Absolute Zero, *Engineering*, A. G. L. J., LXV-22-857
- Efficiency of the London Argand at Different Rates of Gas Consumption with
Special Reference to Its Use as a Gas Testing Burner, Lewis T. Wright,
Continued from XIII-245-38; G. E. M., XIII-246-48
- A Gas Flow Timing Arrangement, "H. B.," *Chemical News*,
J. G. L., LXVIII-1751-1075
- The Use of the Jet Photometer, A. B. Slater, Jr.,
A. G. L. J., LXV-23-889
- Discussion, American Gas Light Association,
A. G. L. J., LXV-23-889
- Burner Tests at Different Angles, Vivian B. Lewes, (Extracts),
A. M. I. W., LXIX-24-842
- L. de Fonblanque, J. G. L., LXVIII-1753-1188
- The Hefner Standard Lamp, *Progressive Age*, P. A., XV-1-9; 2-33
- The Construction of a Bunsen Photometer for Student Use,
A. F. McKissick, P. A., XV-1-15
- Linde on the Liquefaction of Gases, *Journal of Gas Lighting*,
J. G. L., LXIX-1756-20
- The Unit of Light, Hugo Krüss, (Summary), J. G. L., LXIX-1756-25
- Visible and Invisible Light, Silvanus P. Thompson, Report of Four Lectures
Delivered at the Royal Institute, G. W., XXVI-651-58
- Multifarious X Rays, T. C. Porter, J. G. L., LXIX-1757-75
- Compressed Gases and Acetylene, Thomas Maben, (Extract),
P. A., XV-2-24
- Determination of the Calorific Power of Fuels, E. Goutal, P. A., XV-2-31
- Determination of the Calorific Power of Coal, W. Naves, M. Taggart, and
W. Craver, P. A., XV-2-37
- Photometric Value of Various Illuminants Employed in the Lighting of Mines,
A. H. Stokes, A. G. L. J., LXVI-4-129
- A Gas Test at Beckenham, Reversing the Disc, G. W., XXVI-654-173

- Standards of Light Preliminary Report of the Sub-Committee of the American
Institute of Electrical Engineers,
P. A., XIV-19-424; 20-459; 21-496; 22-514
- The New Photometric Method of Prof. Rood, Dr. Hugo Kriiss,
P. A., XIV-19-433
- Acetylene for a Photometric Standard, M. Violle, (Abstract,)
P. A., XIV-20-443
- Photometric Magnitudes and Units, Summarized from the Proceedings of the
Congrès International des Electriciens at Geneva, P. A., XIV-22-522
- Determinations of High Temperatures, H. Hecht, P. A., XIV-23-541
- The Error in Photometry, *Gas World*, P. A., XIV-24-559
- Influence of the Atmosphere upon the Hefner Lamp, E. Boistel,
P. A., XV-3-49
- The Development of Light from Gas Flames, Vivian B. Lewes,
G. W., XXVI-655-203
- Photography in Natural Colors, J. G. L., LXIX-1763-403
- A Recording Pyrometer, Roberts-Austen, (Extract,) J. G. L., LXIX-1764-462
- Actinic Properties of Light, Hypothetical Dangers, *The Lancet*,
P. A., XV-7-138; G. W., XXVI-660-418
- A New Theory of the Ether, S. J. Corrigan, (Extracts,) J. G. L., LXIX-1766-586
- Calorimetry and Heat Unit Value of Gases, Fred B. Wheeler,
A. G. L. J., LXVI-14-518
- Luminescence, Silvanus P. Thompson, (Extract,) J. G. L., LXIX-1769-774
- Notes on Testing Apparatus for Small Gas Works, G. Sisson,
A. G. L. J., LXVI-23-921; G. W., XXVI-667-693;
J. G. L., LXIX-1772-940
- Respirability of Air in which a Candle Flame is Extinguished,
Frank Clowes, (Extract), P. A., XV-9-192
- A Convectionscope and Calorimeter, Alfred R. Bennett,
J. G. L., LXIX-1774-1058
- Photometry, M. Violle, P. A., XV-11-245
- A Novel Property of Carbon, C. C. Swinton, (Extract,) J. G. L., LXIX-1778-1294
- Alexander Wright & Co., Limited, Pioneers of Gas Testing, With an Illus-
trated Description of Apparatus, G. E. M., XIII-253-188
- Capt. Abney on Light and Color Perceptions, J. G. L., LXX-1783-108
- The Junker Calorimeter, *Le Génie Moderne*, June, 1, 1897
- Calibration of a Pilot Tube in Gas Measurements, Forrest M. Towe, *Trans.*
of Assn. of Civ. Engs. of Cornell University, June 1897
- Gas Testing in London, J. V. Taylor, J. G. L., LXX-1788-386
- H. Leicester Greville, J. G. L., LXX-1790-487
- A New Form of Photometer, Silvanus P. Thompson, (Extract,) J. G. L., LXX-1791-526
- Prof. Dixon on Explosions of Gases. J. G. L., LXX-1792-587

MANAGEMENT,

BUSINESS MANAGEMENT AND GENERAL POLICY OF GAS UNDERTAKINGS.

- General Hickenlooper *against* Coke Oven Gas, *Gas World*,
G. W., XXV-637-447
- The Meeting of the Commercial Gas Company,
J. G. L., LXVIII-1743-651; G. W., XXV-637-454
- The Meeting of the Dublin Consumers' Gas Company,
J. G. L., LXVIII-1743-651; G. W., XXV-637-455
- Wages and Hours of Labor at the Leeds Gas Works, Some Comparative
Statistics, J. G. L., LXVIII-1743-653
- Coventry Corporation Gas Supply, Water Gas Plant to be Erected,
J. G. L., LXVIII-1744-697
- The Assessment of the South Metropolitan Gas Works, by the County of
London, J. G. L., LXVIII-1747-853
- Imperial Continental Gas Association, The Vienna Contract,
G. W., XXV-642-634
- The South Metropolitan Gas Company's Rating Appeal,
G. W., XXV-642-636; 655-213
- A Discussion of Various Methods Employed in the Introduction of Gas Stoves,
C. H. Nettleton, A. G. L. J., LXV-19-722
- Discussion, American Gas Light Association, A. G. L. J., LXV-19-726
- Imperial Continental Gas Association, Half Yearly General Meeting,
J. G. L., LXVIII-1748-912
- Dunfermline Gas Works Arbitration, The Proceedings,
J. G. L., LXVIII-1748-915
- The Matlock Bath Arbitration, The Proceedings,
J. G. L., LXVIII-1750-1023; 1751-1082;
G. W., XXV-644-714; 645-749
- Gas Manufacture in Massachusetts, Prof. Wilcox, (Condensed),
M. & C., 3-11-204
- Illuminating Power as Exhibited in the Parliamentary Returns,
Thomas Newbigging, A. G. L. J., LXV-25-972;
G. W., XXV-646-783; J. G. L., LXVIII-1751-1071
- Discussion, Manchester District Asso. of Gas Engineers,
J. G. L., LXVIII-1752-1122
- Gas and Electricity in Manchester, Comparative Cost,
G. E. Stevenson, G. W., XXV-646-779
- (Abstract), A. M. I. W., LIX-26-913
- C. H. Wordingham, G. W., XXV-647-822
- Southport Corporation Gas Supply, The Proposed Reduction in the Illumin-
ating Power and Price of Gas, *Journal of Gas Lighting*,
J. G. L., LXVIII-1753-1191; LXIX-1762-360
- Profit Sharing, George Livesey, G. W., XXVI-651-59
- Notes on Carburetted Water Gas, A. G. Glasgow,
J. G. L., LXIX-1758-124; G. W., XXVI-652-90
- The Southport Gas Committee's Reply to Mr. Bellamy's Report,
J. G. L., LXIX-1758-134

- Low *vs.* High Quality Gas, Inquiry at Southport,
G. W., XXVI-653-131; 656-258
- Ninety Cent Gas in Chicago, *Progressive Age*, P. A., XV-3-59
- Report and Accounts of the Chartered Company, J. G. L., LXIX-1760-225
- Report and Accounts of the South Metropolitan Company,
G. W., XXVI-656-243; J. G. L., LXIX-1761-282
- The Assessment of the South Metropolitan Gas Works,
J. G. L., LXIX-1761-296
- The Gas Light and Coke Company,
G. W., XXVI-656-252; J. G. L., LXIX-1761-298
- A Curious Gas Explosion, Irwin Butterworth, A. G. L. J., LXVI-7-246
- Advertising, E. S. Templeton, P. A., XV-5-100; A. G. L. J., LXVI-7-247
(Abstract), G. W., XXVI-660-415
- Discussion, Ohio Gas Light Association,
P. A., XV-5-101; A. G. L. J., LXVI-8-289
- A Dual Gas Service from One Set of Mains, H. Reinbrecht, P. A., XV-4-83
- Brentford Gas Company, The Half Yearly Meeting,
G. W., XXVI-657-300; J. G. L., LXIX-1762-356
- Crystal Palace District Gas Company, The Half Yearly Meeting,
G. W., XXVI-658-338; J. G. L., LXIX-1762-357; 1763-421
- Some Facts Relating to Gas and Electricity, J. F. Seamon,
A. G. L. J., LXVI-7-244; A. M. I. W., LX-8-265;
P. A., XV-5-95
- Discussion, Ohio Gas Light Association,
P. A., XV-5-96; A. G. L. J., LXVI-8-286
- South Metropolitan Gas Company, Half Yearly Meeting,
J. G. L., LXIX-1763-419; G. W., XXVI-657-297
- Liverpool Gas Company's Meeting, G. W., XXVI-658-338
- Board of Trade Return Relating to Authorized Gas Undertakings,
G. E. M., XIII-249-114
- Day Output, Committee's Report on, New England Association of Gas
Engineers, (with discussion), A. G. L. J., LXVI-9-324
- The 62nd Annual Report of the Operations of the Philadelphia Municipal
Gas Works, (Extracts), A. G. L. J., LXVI-9-330
- Crodon Commercial Gas Company, The Jubilee Meeting,
J. G. L., LXIX-1764-480
- Carburation of Gas by the Consumer, A. M. I. W., LX-10-337
- Tottenham and Edmonton Gas Light and Coke Company, Half Yearly
Meeting, J. G. L., LXIX-1765-547; G. W., XXVI-659-379
- Liverpool Corporation and Carburetted Water Gas. Report of
C. R. Bellamy, J. G. L., LXIX-1765-541
- Separate Meters and Special Prices for Gas Stove Consumption,
Frank S. Richardson, A. G. L. J., LXVI-11-398
- Discussion, N. E. Asso. of Gas Engineers,
A. G. L. J., LXVI-11-399
- One Method of Placing Gas Stoves and Welsbach Lights, L. M. Latta,
A. G. L. J., LXVI-11-404

- The Assessment of the South Metropolitan Gas Works,
J. G. L., LXIX-1766-602
- Question as to the Seizure of a Gas Engine Held on the Hire Purchase System,
J. G. L., LXIX-1766-605
- Sheffield United Gas Light Co., Half-Yearly Meeting,
J. G. L., LXIX-1766-608
- Gas and Meter Testing in Massachusetts, Extracts from Report of C. D.
Jenkins, Inspector of Gas and Meters, J. G. L., LXIX-1766-611
- Some Comparisons of Gas Making, From 1853 to December, 1896, and Some
of the Writer's Experiences at the Small Gas Works at Fitchburg,
H. F. Coggeshall, A. G. L. J., LXVI-12-443
- Manual *vs.* Machine Stoking at Keighley, *Gas World*, G. W., XXVI-662-496
- Commercial Gas Company, Report and Accounts, J. G. L., LXIX-1768-731
- Incandescent Gas *vs.* Electric Light, *Midland Evening News*,
J. G. L., LXIX-1768-734
- Gaseous Fuel as a Means of Cheapening Electricity, Nelson W. Perry,
A. M. I. W., LX-15-517; A. G. L. J., LXVI-14-520;
J. G. L., LXIX-1771-884
- The Rating of Engineering Undertakings, P. Michael Faraday,
G. W., XXVI-664-584
- Fox *vs.* Jerome and Others, The Water Gas Libel Case,
J. G. L., LXIX-1770-839; 1771-890; 1773-996; 1774-1066; 1775-1141
- Gas and Electric Lighting in Massachusetts, From the 12th Annual Report
of the Board, J. G. L., LXIX-1771-892
- The Supply of Water Gas in Birkenhead, Report of Vivian B. Lewes,
J. G. L., LXIX-1771-893
- Paris Gas Company, The Report and Accounts for the Year 1896,
J. G. L., LXIX-1772-952
- Brussels Municipal Gas Supply, The Gas Committee's Report on the Past
Years Working, J. G. L., LXIX-1772-953
- The Water Gas Agitation, Further Objections Raised at Liverpool,
Lieut.-Col. Cayzer, J. G. L., LXIX-1773-1003
- Another Step in Promoting the Union of Capital and Labor, George Livesey,
J. G. L., LXIX-1775-1124; G. W., XXVI-668-774;
G. E. M., XII-255-243
- The Imperial Continental Gas Association, Half-Yearly Meeting,
J. G. L., LXIX-1774-1072; G. W., XXVI-668-784
- A Means of Largely Increasing the Summer Sendout of Gas, J. C. Ford,
A. G. L. J., LXVI-9-725
- Discussion, Texas Association, A. G. L. J., LXVI-19-726
- The Plymouth Nuisance, J. G. L., LXIX-1775-1141; G. W., XXVI-669-833
- Profit-Sharing at Warrington, *Gas World*, G. W., XXVI-670-863
- Paris Gas Company, W. & G. R., VII-11-21
- Selling Gas, I. C. Copley, A. G. L. J., LXVI-22-852; P. A., XV-11-228
- Extracts, G. W., XXVI-675-1096
- Discussion, Western Association,
A. G. L. J., LXVI-22-853; P. A., XV-11-229

- Healthy Rivalry between Gas and Electricity, "Gas Director,"
A. M. I. W., LX-25-877; G. W., XXVI-672-938
- Birmingham Gas Accounts, G. W., XXVI-672-942
- A Few of the Many Details of Management, A. E. Judge,
A. G. L. J., LXVI-22-838
- Discussion, Texas Association, A. G. L. J., LXVI-22-838
- Concerning Carburetted Water Gas, *Journal of Gas Lighting*,
J. G. L., LXIX-1778-1293
- Birmingham Corporation Gas Supply, The Annual Report,
J. G. L., LXIX-1778-1308
- Gas Commissioners' Investigation of the Explosion of Gas at Boston,
A. G. L. J., LXVI-24-965
- Isle of Wight County Court, Successful Claim of the Ventnor Gas and
Water Co., for Damage Caused by a Steam Roller,
J. G. L., LXIX-1779-1366
- Gas Supply in the Out Districts of Manchester, The Differential Charge,
J. G. L., LXIX-1780-1431
- Gas Control from Meter to Burner, An Old Gas Manager,
G. W., XXVI-675-1088
- More Gas Consolidation, Equitable and East River Plan to Combine to
Reduce Expenses, W. & G. R., VIII-1-14
- Paris Gas Accounts, G. W., XXVII-676-20
- Manchester Corporation Gas Works, Annual Report,
J. G. L., LXX-1782-58; 1783-124;
G. W., XXVII-676-24
- Carpenter vs. Commercial Gas Company, The Alkali Act,
J. G. L., LXX-1782-51; G. W., XXVII-676-58
- The Alleged Nuisance at the Plymouth Gas Works, Official Referee's Court,
J. G. L., LXX-1782-47; 1783-117;
G. W., XXVII-678-102
- Abstract,
G. W., XXVII-678-102
- Gas vs. Electricity for Public Lighting at Exeter, A Triumph for Gas,
Journal of Gas Lighting, J. G. L., LXX-1783-127
- Analysis of the Accounts of Certain Gas Undertakings of England, Scotland,
and Ireland for the Year 1896, John W. Field, G. E. M., XIII-254-214
- Carburetted Water Gas for Birkenhead, Report to the Gas Committee,
Vivian B. Lewes, G. E. M., XIII-254-217
- The South Metropolitan Gas Company's Accident Fund, Contracting Out
of the Act,
Gas World, G. W., XXVII-678-91
- Abstract of the Rules, J. G. L., LXX-1784-177
- Abstract from Report of Superintendent of City Gas Works, Richmond, Va.,
Wm. P. Knowles, A. G. L. J., LXVII-4-134
- Mr. Livesey on the Workmen's Compensation Bill, G. W., XXVII-679-129
- Gas Consolidation in New York, *Progressive Age*, P. A., XV-15-333
- European Gas Company, Limited, J. G. L., LXX-1785-229
- Nottingham Corporation Gas Supply, Annual Report and Accounts,
J. G. L., LXX-1785-231

- Ways and Means of Increasing the Sale of Gas, Discussion, North British
Asso. of Gas Managers, P. A., XV-17-380; J. G. L., LXX-1787-316;
G. W., XXVII-681-213
- Ramsgate Gas Supply, Engineer's Report, G. E. M., XIII-255-235
- Ward *vs.* Plymouth Gas Company, The Alleged Nuisance at the Plymouth
Gas Works, J. G. L., LXX-1787-331; G. W., XXVII-682-255
- The Gas Light and Coke Company, Half-Yearly Meeting,
J. G. L., LXX-1787-334; G. W., XXVII-682-248
- Crystal Palace District Gas Company, Half-Yearly Meeting,
J. G. L., LXX-1787-337
- Bonus Day at the South Metropolitan Gas Works, J. G. L., LXX-1787-339
- The South Metropolitan Gas Company, Half-Yearly Meeting,
J. G. L., LXX-1788-390; G. W., XXVII-682-252
- The Supply of Water Gas in Birkenhead, Report of Vivian B. Lewes,
J. G. L., LXIX-1770-846
- The Management of Lighting Plants in Small Towns, Thomas D. Petch,
A. G. L. J., LXVII-7-249
- Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-7-251
- Brentford Gas Company, Half-Yearly Meeting, J. G. L., LXX-1788-392
- Bromley Gas Consumers' Company, Half-Yearly Meeting,
J. G. L., LXX-1788-392
- Liverpool United Gas Light Company, Half-Yearly Meeting,
J. G. L., LXX-1789-440; G. W., XXVII-683-291
- The South Metropolitan Gas Company's Profit-Sharing Scheme,
Pall Mall Gazette, J. G. L., LXX-1789-442
- Crodon Commercial Gas Company, Half-Yearly Meeting,
J. G. L., LXX-1790-490
- Reminiscences of an American Gas Manager, F. H. Eichbaum,
G. W., XXVII-685-359
- Electricity and Gas in Great Yarmouth, W. J. Carpenter,
J. G. L., LXX-1792-577; G. W., XXVII-686-391
- Tottenham and Edmonton Gas Company, Annual General Meeting,
J. G. L., LXX-1791-537
- Burton-on-Trent Corporation Gas Supply, A Further Reduction in Price,
J. G. L., LXX-1792-595
- The Eight-Hour Day in Gas-Works, Statement of the Secretary to the
Gasworkers' Union, G. W., XXVII-687-427
- The Gas Light and Coke Company, Half-Yearly Meeting,
G. E. M., XIV-256-11
- The South Metropolitan Gas Company, Half-Yearly Meeting,
G. E. M., XIV-256-17
- Proposed New Gas Works for Edinburgh and Leith, Report of W. R.
Herring, G. W., XXVII-688-467; J. G. L., LXX-1793-638
- Sheffield United Gas Light Company, Half-Yearly Meeting,
J. G. L., LXX-1793-639
- Bradford Corporation Gas Supply, The Half-Year's Working Results,
J. G. L., LXX-1793-639

Extending Use of Gas in Industrial Operations, F. H. Shelton,
J. G. L., LXX-1794-692

MISCELLANEOUS.

INCLUDING ALSO ARTICLES REFERRING TO ACETYLENE.

- Varying Phases of the Acetylene Question, *American Gas Light Journal*,
A. G. L. J., LXV-14-522
- Experience with Acetylene Gas, J. H. Enright, A. G. L. J., LXV-14-534
- The Gas Industry on the Pacific Coast, *Journal of Gas Lighting*,
J. G. L., LXVIII-1743-637
- North of England Gas Managers' Association Proceedings,
G. W., XXV-638-487; J. G. L., LXVIII-1743-640
- Inaugural Address, J. H. Pennev,
G. W., XXV-638-487; J. G. L., LXVIII-1743-640
- Review of Meeting, *Gas World*, G. W., XXV-638-485
- The Future of Calcium Carbide and Acetylene, (Extract),
James Swinburne, J. G. L., LXVIII-1744-690
- Abstract, A. G. L. J., LXV-19-729
- The Effect of Compression on the Illuminating Power of Gas, E. G. Love.
J. G. L., LXVIII-1744-692
- The Combustion of Acetylene, M. de Chatelier,
G. E. M., XIII-246-52; (Summary) A. M. I. W., LIX-16-553
- Gas Making and Gas Lighting in Dover, *Gas World*, G. W., XXV-639-523
- An Acetylene Gas Explosion, *Journal of Gas Lighting*,
J. G. L., LXVIII-1745-735
- The Dangers of Acetylene, Fatal Explosion in Paris,
J. G. L., LXVIII-1745-754
- A Flooded Gas Works, Special Correspondent, G. W., XXV-640-558
- Mr. Sexton on the Future of Producer Gas, *Journal of Gas Lighting*,
J. G. L., LXVIII-1746-787
- The Explosive Properties of Acetylene, J. G. L., LXVIII-1746-792
- The Important Future of Producer Gas, A. Humboldt Sexton,
W. & G. R., VII-4-19
- Gas vs. Electricity Direct from Coal, D. M. Dunning, E. M., Sept. 1896
- Twenty-Fourth Annual Meeting American Gas Light Association.
Proceedings, P. A., XIV-21-472; A. G. L. J., LXV-18-682; 19-722
- Inaugural Address, C. J. R. Humphreys,
P. A., XIV-21-472; A. G. L. J., LXV-18-684
- Summary, J. G. L., LXVIII-1750-1015; 1753-1182; 1754-1233
- Notes on a Pneumatic Painter, H. P. Maybury,
P. A., XIV-23-537; J. G. L., LXVIII-1747-844
- Acetylene, M. Brevans, G. W., XXV-642-631; A. G. L. J., LXV-21-817
- Acetylene as an Explosive, *Engineer*, J. G. L., LXVIII-1748-923
- Acetylene Gas Tests, *American Manufacturer*, A. M. I. W., LIX-20-697
- Southern District Association of Gas Engineers and Managers,
Proceedings, J. G. L., LXVIII-1749-958; G. W., XXV-643-666

- A Pennyworth of Gas at 2s., 3d. per Thousand Cubic Feet; What Prof. Lambert Says It Will Do, G. W., XXV-643-678; W. & G. R., VII-7-23
- The Net Cost of Different Modes of Lighting, *Journal of Gas Lighting*, J. G. L., LXVIII-1749-957
- Conversion of Culm into Gas,
P. A., XIV-19-428; A. G. L. J., LXV-22-853; 23-893;
A. M. I. W., LIX-21-730
- Changes in the Manufacture of Coke, *American Manufacturer*,
A. M. I. W., LIX-21-733
- The Principle of the Combined Bell and Float Pressure Register,
Communicated, J. G. L., LXVIII-1750-1015
- Horizontal Coke Ovens, Construction of Otto & Co.'s German Patent,
A. M. I. W., LIX-22-768
- Fuel Gas Plant at Halifax, N. S., *Industrial Advocate*,
A. M. I. W., LIX-22-769
- Acetylene the New Illuminant, V. J. Youmans, P. S. M., Oct. 1896
- Providence Iron Works, Millwall, London, England,
Gas Engineers' Magazine, G. E. M., XIII-246-55
- Manchester District Institution of Gas Engineers, Quarterly Meeting at Bradford, G. W., XXV-646-778; J. G. L., LXVIII-1751-1063; 1752-1122
- Compressed Gases and Acetylene, Thomas Maben, (Extract),
G. W., XXV-646-798
- Explosions of Acetylene, *Engineering*, A. G. L. J., LXV-23-894
- Acetylene in Paris, Discussion in the Town Council,
P. A., XV-2-35; A. G. L. J., LXV-26-1011; G. W., XV-647-823
- The Use of Acetylene for Motors, A von Ihering, (Abstract Trans.),
W. & G. R., VII-7-17; J. G. L., LXVIII-1753-1184
- Calcium Carbide and Acetylene, L. Bullier and Ch. de Perrodel,
(Extract), A. M. I. W., LIX-25-877
- Report of the Committee on Education, American Gas Light Association,
Submitted at the St. Louis Meeting, Oct. 1896, A. G. L. J., LXV-25-966
- The Explosive Properties of Acetylene, M. M. Berthelot and Vieille,
(Abstract), A. G. L. J., LXV-20-771; P. A., XIV-23-538;
A. M. I. W., LX-4-123; J. G. L., LXVIII-1754-1134
- From the Milestone, Studying the History of the Industry at the End of
the Year, *Gas World*, G. W., XXV-649-897
- Physiological Effects of the Röntgen Tube, W. M. Stine,
A. G. L. J., LXV-26-1017
- A Retrospect of the Year 1896, *Journal of Gas Lighting*,
J. G. L., LXVIII-1755-1277
- The Future of Calcium Carbide and Acetylene, *Engineering Magazine*,
E. M., XII-3-535
- A Large Fuel Gas Plant, *Water and Gas Review*, W. & G. R., VII-6-23
- Trial of Petroleum as Fuel for Boilers, with Movable Hearths,
L. Le Chatelier, A. M. I. W., LX-1-15
- The Recollections of a Country Gas Manager, "By an Old One,"
A. G. L. J., LXVI-3-89; 5-166; 12-446;
G. W., XXVI-650-15; XXV-652-88; 654-165

- Gas Manufacture and Appliances, Henry O'Connor,
G. W., XXVI-650-16; 651-56; 653-125; 654-166
- Machinery Attached to the Soil, *American Gas Light Journal*,
A. G. L. J., LXVI-2-53
- Acetylene Gas Motor Car, *Progressive Age*, P. A., XV-2-24
- Rules in Regard to the Preparation of Acetylene in Paris, P. A., XV-2-38
- The Dryness of Steam, Osborne Reynolds, (Extract),
A. G. L. J., LXVI-3-90
- Jubilee of Berlin Municipal Gas Works,
Gas World, G. W., XXVI-653-127
Journal of Gas Lighting, J. G. L., LXIX-1759-177
- Duty on Natural Gas, Curious Contention before the United States Circuit
Court, W. & G. R., VII-7-23
- The Old Soho Works of Boulton & Watt, *Cassiers Magazine*,
C. M., XI-5-413
- Rule for Estimating the Power Factor in the Cost of Carbide of Calcium,
F. Jarvis Patten, P. A., XIV-19-428
- Acetylene for a Photometric Standard, M. Violle, P. A., XIV-20-443
- Description of the Belfast Gas Works, James Stelfox,
P. A., XIV-20-455; 21-497
- The Action of Gas on Vegetation, *Progressive Age*, P. A., XIV-20-469
- Late Items about Acetylene, *Progressive Age*, P. A., XIV-20-501
- The Gas Industry Building at the Berlin Industrial Exposition of 1896,
P. A., XIV-22-512
- Natural Gas, Early Predictions as to the Permanency of Supply at Fault,
Gradual Decrease of Output at all Points, J. M. Buckley,
P. A., XIV-22-513
- Carbide of Lanthanum, Henri Moissan, P. A., XIV-22-521
- The Use of Oxygen in Gaseous Poisoning, P. A., XIV-24-555
- On Smokeless Combustion and Boiler Firing, Walther Hempel,
P. A., XIV-24-561
- The Explosiveness of Acetylene, M. Brevans, P. A., XIV-24-561
- The Coke Trade of Connellsville in 1896, *Connellsville Courier*,
A. G. L. J., LXVI-5-167
- Carbide of Calcium, *Progressive Age*, P. A., XV-3-47
- Professor Ramsay on Chemical Studies, *Journal of Gas Lighting*,
J. G. L., LXIX-1760-229
- The Agitation against Water Gas in Liverpool, *Journal of Gas Lighting*,
J. G. L., LXIX-1760-244
- Report on the Preparation and Use of Acetylene for Lighting Purposes,
M. Vieille, A. M. I. W., LX-6-193
- "Gassing," Its Prevention and Cure, *Journal of Gas Lighting*,
J. G. L., LXIX-1761-286
- The Derivation of the Word "Gas," J. G. L., LXIX-1761-289
- Carburetted Water Gas and Carbon Monoxide, Humphreys & Glasgow,
J. G. L., LXIX-1761-294
- Cost of Acetylene, Vivian B. Lewes, (Extract), A. M. I. W., LX-7-229

- Experiments on the Combustion of Acetylene and Air Mixtures,
H. Le Chatelier, A. M. I. W., LX-7-229
- The Southern District Meeting,
J. G. L., LXIX-1762-344; G. W., XXVI-656-245
- Inaugural Address, J. W. Helps,
J. G. L., LXIX-1762-344; G. W., XXVI-656-246
- Some Facts Relating to Gas and Electricity, J. F. Seamon,
A. G. L. J., LXVI-7-244
- The Ohio Gas Light Association,
Proceedings, A. G. L. J., LXVI-8-279; 9-326;
P. A., XV-4-68; 5-92
- President's Address, Jerome Penn,
A. G. L. J., LXVI-7-238; P. A., XV-4-69
- Abstract of Proceedings, J. G. L., LXIX-1766-587
- Midland Association of Gas Managers,
Proceedings, J. G. L., LXIX-1764-463; G. W., XXVI-658-330
- Inaugural Address, John Young,
J. G. L., LXIX-1764-463; G. W., XXVI-658-330
- Acetylene Gas, Eng., London, Dec. 11, 1896
- Twenty-seventh Annual Meeting, New England Association of Gas Engineers,
Proceedings, A. G. L. J., LXVI-9-318; 10-358; 12-438
- Summary, J. G. L., LXIX-1768-713; 1769-771
- Inaugural Address, C. D. Lamson, A. G. L. J., LXVI-9-319
- The Storage of Calcium Carbide and Acetylene,
London Chemical Trade Journal, P. A., XV-5-105
- Coke Oven Gas, George Hausdorff, (Extract), P. A., XV-5-107
- The Home Office and Carbide of Calcium,
J. G. L., LXIX-1764-459; 1766-552
- Manchester District Institution of Gas Engineers,
Proceedings, G. W., XXVI-659-369; J. G. L., LXIX-1764-470
- Inaugural Address, Robert Porter,
G. W., XXVI-659-370; J. G. L., LXIX-1764-470
- Some Remarks on Coke Ovens and their Products, S. J. Fowler,
A. G. L. J., LXVI-10-366
- Discussion, New England Association of Gas Engineers,
A. G. L. J., LXVI-10-369
- Fourth Annual Meeting, Michigan Gas Association,
Synopsis of Proceedings,
J. G. L., LXIX-1768-714; A. G. L. J., LXVI-11-404
- "Snags," L. E. Walker, A. G. L. J., LXVI-11-406
- Late Acetylene Notes, P. A., XV-6-120
- The Acetylene Explosion Trials, P. A., XV-6-127; 7-140; 8-164; 9-186
- America's First Gas Exposition, P. A. Sup., March 1897
- Address, Charles F. Chandler, P. A. Sup., March 1897, P. 12
- Address, Henry Morton, P. A. Sup., March 1897, P. 14
- Water Distribution in Scrubbers, F. Burgemeister, J. G. L., LXIX-1766-588

- Electricity Direct from Carbon, Willard E. Case, (Abstract),
A. M. I. W., LX-12-407
- Coke Oven Gas, S. J. Fowler, (Abstract), A. M. I. W., LX-12-410
- Safety Measures Against Acetylene Gas, *American Manufacturer*,
A. M. I. W., LX-12-410
- A German Conference on Acetylene, J. G. L., LXIX-1767-645
- Researches on Acetylene, J. G. L., LXIX-1767-653
- The Recent Fatal Gas Explosion in Boston, J. G. L., LXIX-1767-674
- Cleaning Structural Iron Work by the Sand Blast, *American Manufacturer*,
A. M. I. W., LX-13-441
- Use of Liquid Fuel, M. Wallis, (Abstract), A. M. I. W., LX-13-446
- Gas Supply, *Engineering, London*, Eng., Lon., Jan. 1, 1897
- The Light of the Future, An Austrian Inventor of a Phosphorescent Lamp
which Gives Forth a Cold Light, *Water and Gas Review*,
W. & G. R., VII-9-8
- Artificial Light, Modern Methods Compared, Electric, Incandescent,
Welsbach, Acetylene, D. S. Jacobus, (Abstract), P. A., XV-7-137
- Restrictions Placed on Carbide of Calcium in England, English Home
Office, P. A., XV-7-147
- The Manufacture of Coke at Bilbao, *Colliery Guardian*,
A. M. I. W., LX-14-480
- Gas from Lignite, *Zeit für Berg. Hütten und Salinenwesen*,
A. M. I. W., LX-14-482
- New Acetylene Generator, John Schumacher's Patent,
A. M. I. W., LX-14-482
- German Chemists Discuss Acetylene,
A. G. L. J., LXVI-21-807; P. A., XV-9-190;
A. M. I. W., LX-18-627; G. W., XXVI-663-542
- Medical Opinions on Water Gas, Thomas Cayzer, J. G. L., LXIX-1769-789
- The Gas Managers of Scotland,
Address, W. Smith, J. G. L., LXIX-1770-827; G. W., XXVI-664-578
- Acetylene on Board Ships, Vivian B. Lewes, (Abstract),
P. A., XV-9-192; A. G. L. J., LXVI-17-647;
G. W., XXVI-664-583
- Calcium Carbide, M. Ravel, (Abstract), A. G. L. J., LXVI-15-567
- The Improved Fleuss Breathing Apparatus for Mine Exploration,
George H. Winstanley, (Abstract), A. G. L. J., LXVI-15-570
- Waverly Association of Gas Managers, J. G. L., LXIX-1770-831
- Use of Acetylene for Buoys and Lighthouses, Vivian B. Lewes,
(Abstract), J. G. L., LXIX-1770-833
- The Aluminium and Calcium Carbide Works at the Falls of Foyers,
R. W. Wallace, (Abstract Report), J. G. L., LXIX-1770-848
- Liquefied Acetylene, *Progressive Age*, P. A., XV-8-157
- A Valve for Vessels Intended to Contain Compressed or Liquefied Gas,
P. A., XV-8-173
- Illuminating Power of Burning Oils, *Chemical Trade Journal*,
A. M. I. W., LX-16-554

- The Explosibility of Liquid Acetylene, Prof. Clowes, (Abstract),
J. G. L., LXIX-1771-883; G. W., XXVI-665-615;
P. A., XV-10-208
- Carbide under License, *Gas World*, G. W., XXVI-665-622
- The Future of Acetylene, Ireland as a Centre of the Industry,
Gas World, G. W., XXVI-665-623
- Acetylene, Apparatus for Lighting with Acetylene, S. A. S., Feb. 27, 1897
- A New Means of Storing Acetylene, C. Claude and A. Hess, (Extract),
J. G. L., LXIX-1771-886
- The London County Council and Carbide of Calcium, A. Spencer,
(Abstract), J. G. L., LXIX-1771-892
- Proposed Utilization of the Water Power of Ireland for the Manufacture
of Calcium Carbide, J. G. L., LXIX-1771-895
- Eastern Counties' Gas Managers' Association,
Proceedings, J. G. L., LXIX-1772-933; G. W., XXVI-666-652
Presidential Address, J. T. Jolliffe,
J. G. L., LXIX-1772-933; G. W., XXVI-666-653
- North of England Gas Managers' Association,
Proceedings, J. G. L., LXIX-1772-940; G. W., XXVI-667-691
Inaugural Address, J. H. Penney,
J. G. L., LXIX-1772-940; G. W., XXVI-667-691
- Acetylene Gas in Philadelphia, P. A., XV-9-181
- Oil Lighting by Constant Supply, P. A., XV-9-193
- Acetylene for Laboratory Use, A. E. Munby, (Extract),
J. G. L., LXIX-1773-985
- Meeting of the Incorporated Institution of Gas Engineers,
Editorials, J. G. L., LXIX-1774-1037; G. W., XXVI-668-739
Proceedings, J. G. L., LXIX-1774-1039; 1775-1108;
G. W., XXVI-668-745
- Inaugural Address, Corbet Woodall,
A. G. L. J., LXVI-25-996; J. G. L., LXIX-1774-1041;
G. E. M., XIII-254-209; G. W., XXVI-668-745
- The Utilization of Fuels, "R" in *Le Genie Civil*,
A. G. L. J., LXVI-19-721; 20-765; 21-805
- Third Annual Meeting, Texas Gas and Electric Light Association,
Proceedings,
A. G. L. J., LXVI-19-724; 20-759; 21-801; 22-838; 23-869
Abstract, J. G. L., LXIX-1778-1296; 1779-1356
Inaugural Address, T. D. Miller, A. G. L. J., LXVI-19-725
- The Examination in Gas Manufacture, The Question Papers,
J. G. L., LXIX-1774-1072
- Street Lighting and Gas and Meter Testing in Liverpool, Report by
C. R. Bellamy, J. G. L., LXIX-1774-1074
- Recent Foreign Notes on Acetylene, P. A., XV-10-202
- Calcium Carbide as a Reducing Agent, H. N. Warren, P. A., XV-10-205
- Acetylene Illumination, *Progressive Age*, P. A., XV-10-206
- Marsh Gas Used for Heating Purposes, P. A., XV-10-210

- Acetylene *vs.* Coal Gas, T. D. Miller, (Extract,) A. M. I. W., LX-21-732
 Combustion of Acetylene and Air, A. M. I. W., LX-21-732
 A New Coke Oven, A. M. I. W., LX-21-733
 Odds and Ends, J. H. Fitzgerald, A. G. L. J., LXVI-21-802
 Discussion, Texas Association, A. G. L. J., LXVI-21-803
 The Automatic Ignition of Gas, *Journal of Gas Lighting*,
 A. G. L. J., LXVI-24-966; J. G. L., LXIX-1776-1186
 American View of Acetylene, *Journal of Gas Lighting*,
 J. G. L., LXIX-1776-1186
 The Fatal Gas Explosion in Boston, Judge Ely's Report, (Abstract),
 J. G. L., LXIX-1776-1198
 Editorial, *Journal of Gas Lighting*, J. G. L., LXIX-1780-1406
 Reports of the Massachusetts Gas and Electric Light Commissioners,
 J. G. L., LXIX-1781-1511
 Manchester District Institution of Gas Engineers, Visit to the Preston
 Gas Works, G. W., XXVI-671-901
 Acetylene, A Discussion of the Properties, its Dangerous Qualities and
 Advantages as an Illuminant, F. & W., Mar. 6, 1897
 Twentieth Annual Meeting of the Western Gas Association,
 Proceedings, A. G. L. J., LXVI-22-845; 23-902; 24-950
 P. A., XV-11-221; 12-258
 Summary, J. G. L., LXIX-1780-1420; 1781-1497
 President's Address, W. H. Odiorne,
 A. G. L. J., LXVI-22-845; P. A., XV-11-222
 Wrinkle Department, George T. Thompson,
 A. G. L. J., LXVI-22-863; P. A., XV-11-239
 Discussion, Western Association,
 A. G. L. J., LXVI-22-866; P. A., XV-11-241
 The Future Gas Engineer, Corbet Woodall, (Extract), P. A., XV-11-246
 The Explosive Properties of Acetylene, Francis C. Phillips,
 A. M. I. W., LX-23-805; 24-842
 Acetylene and its Liability to Explosion, Dr. Slaby, G. A. G. B., Apr. 1, 1897
 Letang & Serpollet's Acetylene Lamp, A. Etancon, S. A. S., May 1, 1897
 The Incorporated Gas Institute,
 Proceedings, G. E. M., Sup. June 1897; G. W., XXVI-674-1014;
 J. G. L., LXIX-1779-1344; 1780-1410; 1781-1475; LXX-1782-16
 Review of Proceedings, J. G. L., LXIX-1780-1408
 Inaugural Address, C. Stafford Eilery,
 A. G. L. J., LXVII-1-3; G. W., XXVI-674-1015;
 J. G. L., LXIX-1779-1344
 Annual Report, G. E. M., XIII-253-199
 Recent Research on Acetylene, G. E. Brown,
 P. A., XV-14-313; J. G. L., LXIX-1779-1354
 Acetylene Notes, P. A., XV-12-287
 The Gas Institute in Bath, *Gas World*, G. W., XXVI-674-1003

- The Societé Technique du Gaz en France,
J. G. L., LXIX-1781-1495; LXX-1783-109; 1784-163;
G. W., XXVI-674-1069
- Gas Literature and Statistics, Made in Germany, *Journal of Gas Lighting*,
J. G. L., LXIX-1780-1419
- The Paris Gas Meeting, *Gas World*, G. W., XXVI-675-1090
- The Recovery of Benzol from Coke Oven Gases, *Journal of Gas Lighting*,
J. G. L., LXIX-1781-1493
- German Association of Gas and Water Engineers, (Summary),
G. W., XXVII-676-19; J. G. L., LXIX-1781-1499; LXX-1784-163
- Association of Gas and Water Engineers of Austria-Hungary,
J. G. L., LXIX-1781-1500
- The Meeting of the Dutch Association of Gas Managers,
G. W., XXVII-676-20
- The Plymouth Nuisance, *Gas World*, G. W., XXVII-677-60
- A Speculation Regarding the Cause of Roentgen Rays, Elihu Thomson,
A. G. L. J., LXVII-2-52
- Acetylene Regulation in Switzerland, J. G. L., LXX-1782-37
- The Patent Side of Acetylene Gas, E. N. Dickerson, P. A., XV-14-323
- Carburetted Water Gas as an Enricher of Coal Gas,
Engineering Magazine, E. M., XIII-4-623
- The Education of the Engineer, *Electrical Review*, G. W., XXVII-678-96
- Failure of Fuel Gas, F. H. Shelton, (Author's Summary),
G. W., XXVII-678-99
- Fifth Annual Meeting, Pacific Coast Gas Association,
A. G. L. J., LXVII-4-122; 7-242; 8-282; 9-322; 11-403
- Abstract, J. G. L., LXX-1790-479
- Presidential Address, T. R. Parker, A. G. L. J., LXVII-6-208
- A Page in the History of Gas Lighting, *Journal of Gas Lighting*,
J. G. L., LXX-1784-160
- Fire Office Rules for Lighting by Liquefied Acetylene, J. G. L., LXX-1784-162
- Proposal to Light Merchantsville (N. J.) by Acetylene, *Progressive Age*,
P. A., XV-12-168
- Acetylene for Metal Smelting, A. M. I. W., LXI-5-157
- The History, Status and Possibilities of Acetylene, Henry H. Suplee,
E. M., XIII-5-787
- Abridged from the *Engineering Magazine*, G. W., XXVII-684-320
- Carbide of Calcium and Acetylene, (Summary), J. G. L., LXX-1791-527
- North British Association of Gas Managers,
Report of Meeting, J. G. L., LXX-1786-266; G. W., XXVII-680-171
- Inaugural Address, A. Bell,
J. G. L., LXX-1786-268; 1787-316; G. W., XXVII-680-171
- Water Gas Manufacture in England, President Ellery, (Extract),
A. M. I. W., LXI-6-195
- Gasometers as Cannon Targets, *Progressive Age*, P. A., XV-16-353
- Water Gas as an Illuminant, Hugo Strache, P. A., XV-16-356
- Storing Calcium Carbide, *Chemical Trade Journal*, P. A., XV-16-361

- Gas at the Berlin Exposition, P. A., XV-16-362
- Acetylene Regulation in Switzerland, W. & G. R., VIII-2-22
- Bye-Product System of Coke Making, William Gilbert Irwin,
C. M., XII-5-581
- The City of Montreal *vs.* The Standard Light and Power Company,
J. G. L., LXX-1787-330
- North of Ireland Association of Gas Managers,
Proceedings, J. G. L., LXX-1788-374; G. W., XXVII-682-243
Inaugural Address, J. Nisbett,
J. G. L., LXX-1788-375; G. W., XXVII-682-243
- A Description of an Acetylene Gas Plant, C. B. Outon,
J. G. L., LXX-1789-433; G. W., XXVII-682-246
- Reminiscences of Gas Manufacturing and Kindred Matters,
F. H. Eichbaum, A. G. L. J., LXVII-7-244
Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-7-245
- The German Gas Meeting, Presidential Address, L. Körting,
G. W., XXVII-683-280
- The Uniformity of Gas Accounts, C. O. G. Miller,
A. G. L. J., LXVII-8-284
Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-8-286
- The Parliamentary Returns Relating to Gas Undertakings,
J. G. L., LXX-1789-429
- Electricity *vs.* Gas for Lighthouse Illumination, J. Kenward, (Extract),
J. G. L., LXX-1789-436
- The Early Days of Gas, *Dundee Advertiser*,
J. G. L., LXX-1790-492; G. W., XXVII-684-324
- Card Bookkeeping, V. Stow, A. G. L. J., LXVII-9-325
Discussion, Pacific Coast Gas Association, A. G. L. J., LXVII-9-326
- Wrinkle Department, Pacific Coast Gas Association,
A. G. L. J., LXVII-9-328; 10-352
- Acetone in the Acetylene Industry, *Am. Manufacturer*,
A. G. L. J., LXVII-9-334
- Manchester District Institution of Gas Engineers, Quarterly Meeting,
J. G. L., LXX-1790-477; G. W., XXVII-68-5354
- A Descriptive Sketch of the Elland-Cum-Gretland Gas Undertaking,
Robert Porter, G. W., XXVII-685-354; J. G. L., LXX-1790-477
- Solutions of Acetylene and Their Explosive Properties,
Berthelot and Vieille, P. A., XV-17-382
- Toxic Properties of Acetylene, N. Gréhaut, (Extract),
Comptes Rendus, Vol. 121-564; P. A., XV-17-384
- Properties of Acetone, P. A., XV-17-387
- Lighting the Niagara University with Acetylene Gas, Owen E. Duilap,
P. A., XV-17-388
- The Experience Department, Pacific Coast Gas Association,
A. G. L. J., LXVII-10-365
- Meeting of the Manchester District Institution, *Gas World*,
G. W., XXVII-685-353

- Tottenham and Edmonton Gas Light and Coke Company,
Annual Meeting, G. W., XXVII-685-360
- Some Abstracts from a Review of Some Articles Printed in the *Journal*
für Gasbeleuchtung, Frederic Egner, A. G. L. J., LXVII-11-407
- The Extending Use of Gas in Industrial Operations, Frederick H. Shelton,
A. G. L. J., LXVII-11-408
- Mayor Todd of Louisville, Ky., Refers in His Annual Message to the City's
Interest in the Shares of the Louisville Gas Company,
A. G. L. J., LXVII-11-413
- Progress in Acetylene Appliances, P. A., XV-18-409
- Gas in Indiana, *Indianapolis Journal*, P. A., XV-18-410
- Test of Electric Heater in Comparison with Commercial Alcohol (95 per cent)
and Wood Alcohol, James S. Stevens and Burton S. Lanphear,
P. A., XV-18-411
- Acetylene for Military Signalling, A. E. Munby, (Extract),
P. A., XV-18-417
- Re-Heating and Changes of the Forms of Carbon, A. Ledebur,
(Summary), A. M. I. W., LXI-12-407
- Natural Gas Production in the United States, From the Annual Report
of the U. S. Geological Survey,
A. G. L. J., LXVII-13-490; A. M. I. W., LXI-12-409
- Eastern Counties Gas Managers' Association,
J. G. L., LXX-1792-577; G. W., XXVII-686-391; 687-430
- Painting Buildings by Compressed Air, J. J. Hubbell,
Michigan Engineers' Annual, 1897, A. G. L. J., LXVII-12-447
- Paint Tests, Max Toltz, A. G. L. J., LXVII-12-451
- The Local Government Board on Carburetted Water Gas,
Journal of Gas Lighting, J. G. L., LXX-1791-522
- Pacific Coast Gas Association, J. G. L., LXX-1791-530; 1792-583; 1794-682
- Waverly Association of Gas Managers, Half-Yearly Meeting,
J. G. L., LXX-1792-582
- Willson's Patent for the Production of Carbide of Calcium,
An Alleged Infringement, J. G. L., LXX-1792-591
- Utilizing the Waste Heat of Gas Lamps, *Journal of Gas Lighting*,
J. G. L., LXX-1793-641
- The Institution of Gas Engineers on the Continent, G. W., XXVII-688-400
- Amalgamation of Meter Makers, Particulars of the Proposal,
G. W., XXVII-688-466
- The Continental Excursion of the Institution of Gas Engineers,
Journal of Gas Lighting, J. G. L., LXX-1794-674

NEW PUBLICATIONS.

- THE GAS AND OIL ENGINE, by Dugald Clerk. Sixth edition, 8vo., revised and enlarged. Illustrated, 558 pp. London: Longmans, Green & Co., 15s. 1896. New York: John Wiley & Sons.
- A PRACTICAL TREATISE ON THE "OTTO" CYCLE GAS ENGINE, by William Norris. Illustrated. Longmans, Green & Co., 1896. Cloth, \$3.
- THE GASES OF THE ATMOSPHERE, by William Ramsay. London: Macmillan & Co., Limited. Price, 6s.
- CHEMISTRY FOR ENGINEERS AND MANUFACTURERS. Vol. II. By Bertram Blount and A. G. Bloxam. London: Charles Griffin & Co., Limited. Price, 16s.
- PROCEEDINGS OF THE NORTH BRITISH ASSOCIATION OF GAS MANAGERS and Statistical Report of the Gas Supply of Scotland. Published by the Association.
- ROENTGEN RAYS AND PHENOMENA OF ANODE AND CATHODE: Principles, Applications and Theories, by Edward P. Thompson. With a Chapter by Prof. Wm. A. Anthony. New York: D. Van Nostrand Company (Written Aug. 1896.)
- FUEL AND REFRACTORY MATERIALS, by A. Humboldt Sexton. London: Blackie & Son, Limited. Small octavo, 1897. 352 pp., illustrated 105. Cloth, \$2.
- GAS AND FUEL ANALYSIS FOR ENGINEERS, by Augustus H. Gill. New York: John Wiley & Sons. London: Chapman & Hall, Limited, 1896.
- THE STORY OF AMERICAN COALS, by William Jasper Nichols. J. B. Lippincott Co., Philadelphia, 1896. Cloth.
- DIE OEFFENTLICHE BELEUCHTUNG VON BERLIN, by H. Lux. Berlin: S. Fisher. 500 pp.
- GAS, OIL AND AIR ENGINES, by Bryan Donkin. London: Charles Griffin & Co. Philadelphia: J. B. Lippincott Co.
- PRACTICAL GAS FITTING. Reprint from the Metal Worker. D. Williams, New York, 1896. Cloth, \$1.
- L'ECLAIRAGE À L'ACETYLENE: Historique—Fabrication—Appareils—Applications—Dangers; Georges Pellissier. Paris: Carré & Naud, 3 Rue Racine. Price, 5 francs, bound.
- METALLIC STRUCTURES: Corrosion and Fouling, and their Prevention, by John Newman. London: E. & F. N. Spon, 1896.
- GAS, GASOLINE AND OIL VAPOR ENGINES, by Gardner D. Hiscox. New York: Norman W. Henley & Co., 1897. Cloth, \$2.50.
- AN ELEMENTARY TREATISE ON HEAT AND HEAT ENGINES, by W. C. Popplewell. Manchester: The Technical Publishing Co., 1897. 375 pp. 6s net.
- RAPPORT SUR LE GAZ L'EXPOSITION INDUSTRIELLE DE BERLIN, 1896, by M. Ad. Bouvier. Paris: La Société Technique de l'Industrie du Gaz, 63 Rue de Provence, and at P. Mouillot, Printer, 13 Quai Voltaire.
- A PRACTICAL TREATISE ON MODERN GAS AND OIL ENGINES, by Frederick Groves. Technical Publishing Company, Limited, Manchester, Eng.

OFFICERS
OF THE
AMERICAN GAS LIGHT ASSOCIATION.
1897.

President :

J. B. CROCKETT,.....SAN FRANCISCO, CAL.

Vice-Presidents :

A. C. HUMPHREYS,.....NEW YORK, N. Y.
G. G. RAMSDELL,.....PHILADELPHIA, PA.
E. G. PRATT, ...DES MOINES, IOWA.

Secretary and Treasurer :

ALFRED E. FORSTALL, ...MONTCLAIR, N. J.

Members of the Council :

Terms Expire 1898.	Terms Expire 1899.
ROBERT YOUNG,.....Allegheny, Pa.	I. C. BAXTER,.....Detroit, Mich.
J. A. P. CRISFIELD,...Savannah, Ga.	A. S. MILLER, ...Long Island City.
W. R. BEAL,.....New York, N. Y.	E. H. JENKINS, ...Covington, Ky.
B. E. CHOLLAR,.....St. Louis, Mo.	C. F. PRICHARD,. Lynn, Mass.

Ex-officio, Junior Past President :

CHARLES H. NETTLETON, ... DERBY, CONN.

PAST PRESIDENTS.

*Charles Roome	1873-79
*William H. Price.....	1880-1881
Andrew Hickenlooper	1882
*Theobald Forstall	1883
William A. Stedman	1884
Eugene Vanderpool.....	1885
Austin C. Wood.....	1886
Malcolm S. Greenough.....	1887
Thomas Turner	1888
Alpheus B. Slater.....	1889
Emerson McMillin	1890
John P. Harbison	1891
William Henry White.....	1892
Arthur E. Boardman.....	1893
William H. Pearson	1894
Walton Clark.....	1895
C. J. R. Humphreys.....	1896
Chas. H. Nettleton	1897

PAST SECRETARIES.

Henry Wurtz	1873
*Peter E. Demill	1874
*Charles Nettleton	1875-79
William Henry White.....	1880-83
C. J. R. Humphreys.....	1884-91
A. B. Slater, Jr.	1892-96

*Deceased.

MEMBERS
OF THE
AMERICAN GAS LIGHT ASSOCIATION,
1897-98.

(The date with each name is that of election to membership.)

HONORARY MEMBERS.

- Barker, Forrest E. October 27, 1896.
Chairman of Massachusetts Board of Gas and Electric Light
Commissioners, Boston, Mass., State House, Room 145.
- Chandler, C. F. October 21, 1875.
41 East 49th street, New York, N. Y., Dean, Columbia Col-
lege, School of Mines.
- Foote, Allen R. October 17, 1894.
Tacoma Park, D. C.
- Greenough, William W. October 16, 1878.
299 Marlborough street, Boston, Mass.
- King, William. October 18, 1877.
Duke street, Liverpool, England, Engineer of Liverpool
United Gas Light Co.
- Livesey, George T. October 20, 1897.
M.I.C.E., etc., Chairman of South Metropolitan Gas Company,
Old Kent Road, London, England.
- Love, E. G. October 20, 1886.
122 Bowery, New York, N. Y., Gas Examiner, Department
Public Works, of New York City.
- Morton, Henry. October 18, 1878.
Hoboken, N. J., President of Stevens Institute of Technology.
- Woodall, Corbet. October 20, 1897.
M.I.C.E., etc., Palace Chambers, Westminster, London, Eng-
land.

ACTIVE MEMBERS.

- Abel, W. G. October 20, 1886.
42 West Baker street, Atlanta, Ga., P. O. Box 311, Engineer
of Atlanta Gas Light Co.
- Adams, Charles F. October 17, 1894.
235 Stark street, Portland, Oregon, P. O. Box 73, President
of Portland Gas Co.
- Adams, Harry C. October 20, 1886.
224 South Third street, Philadelphia, Pa., P. O. Box 1322,
Vice-President of Westmoreland Coal Co.
- Addicks, J. Edward. October 20, 1886.
1500 Market street, Philadelphia, Pa.
- Addicks, Frederick P. October 15, 1890.
24 West street, Boston, Mass., Treasurer of Boston Gas Light
and Bay State Gas Cos.
- Addicks, Walter R. October 15, 1890.
24 West street, Boston, Mass., Chief Engineer of Boston, Bay
State, and Brookline Gas Cos.
- Africa, Walter G. October 21, 1891.
46 Hanover street, Manchester, N. H., Treasurer and Super-
intendent of Peoples Gas Light Co.
- Allen, Augustus L. October 20, 1875.
348 Mill street, Poughkeepsie, N. Y., General Manager of the
Allen-Harris Process.
- Anderson, William. October 16, 1889.
32 Condor street, East Boston, Mass., Superintendent of East
Boston Gas Co.
- Archer, Benjamin F. October 16, 1879.
319 Cooper street, Camden, N. J., President of Camden Gas
Light Co.
- Armington, James H. October 19, 1881.
Riverside, R. I., P. O. Box 41.
- Armington, William A. October 19, 1892.
10 Wall street, New York, N. Y., General Manager of Voelker
Light Company.
- Bailey, Charles B. October 16, 1889.
1424 Staughton street, Washington, D. C., P. O. Box 56.

- Barret, A. H. October 16, 1878.
Sixth and Green streets, Louisville, Ky., Vice-President and Engineer Louisville Gas Company.
- Barrett, W. E. October 16, 1895.
Stark avenue, Ardmore, Pa., P. O. Box 77, Superintendent and Secretary of the Lower Merion Gas Co.
- Bartlett, Edward L. October 20, 1886.
McHenry and Scott streets, Baltimore, Md., P. O. Box 960, Mechanical Engineer of Bartlett, Hayward & Co.
- Battin, Isaac. October 15, 1873.
217 South 13th street, Omaha, Neb., Treasurer and Engineer of the Omaha Gas Manufacturing Co.
- Baumgardner, John H. October 15, 1879.
129 North Queen street, Lancaster, Pa., Secretary of Lancaster Gas Light and Fuel Co.
- Baxter, Isaac C. October 18, 1882.
636 Trumbull avenue, Detroit, Mich., Superintendent and Engineer of the Detroit Gas Co.
- Baxter, Robert. October 19, 1881.
Halifax, N. S., Manager of Halifax Gas Light Co., Limited.
- Baxter, William H. April 16, 1873.
201 Sycamore street, Petersburg, Va., P. O. Box 574, Treasurer and Superintendent of Petersburg Gas Light Co.
- Beadenkopf, George. October 21, 1891.
19 South street, Baltimore, Md., Assistant Engineer of Consolidated Gas Co.
- Beadle, A. B. October 21, 1891.
813 Drexel building, Philadelphia, Pa., Gas Engineer with the United Gas Improvement Co.
- Beal, Thaddeus R. October 21, 1891.
138th street and East River, New York, N. Y., Superintendent of Central Union Gas Co.
- Beal, William R. May 13, 1874.
350 Alexander avenue, New York, N. Y., President of Central Union Gas Light Co.
- Benson, Fred S. October 20, 1875.
Kent avenue, cor. of Cross street, Brooklyn, N. Y., Chief Engineer, Eastern Division of the Brooklyn Union Gas Co.

- Betts, Edward. October 17, 1888.
827 Market street, Wilmington, Del., P. O. Box 999, President
of Wilmington Coal Gas Co.
- Bigelow, Arthur F. October 19, 1892.
540 Hamilton street, Allentown, Pa., Superintendent of Allen-
town Gas Co.
- Bigelow, Henry N. October 17, 1888.
104 High street, Clinton, Mass., P. O. Box 1156, Treasurer
and General Manager of Clinton Gas Light Co.
- Bissell, West. October 20, 1897.
Jersey City, N. J., Assistant Superintendent United Gas Im-
provement Company, Jersey City, N. J.
- Blodget, Charles W. October 15, 1884.
324 Bedford avenue, Brooklyn, E. D., N. Y., P. O. Box 23,
Manager and Engineer of Williamsburgh Branch, Brooklyn
Union Gas Co.
- Boardman, Arthur E. October 15, 1884.
Brevard, N. C., President and Engineer of Macon Gas Light
and Water Co., Macon, Ga.
- Boardman, A. J. October 27, 1896.
Roberts Building, Tampa, Fla., Manager of Tampa Gas Co.
- Boardman, Henry. October 17, 1888.
5 Forest avenue, Bangor, Maine.
- Bodine, Samuel T. October 20, 1886.
813 Drexel Building, Philadelphia, Pa., 2d Vice-President and
General Manager of the United Gas Impt. Co.
- Bogert, W. Russell. October 19, 1892.
Bristol, R. I., P. O. Box 387, Treasurer of Bristol County Gas
and Electric Company.
- Borgner, Cyrus. October 13, 1880.
23d street above Race, Philadelphia, Pa., Manufacturer of Fire
Brick and Clay Retorts.
- Bowen, William S. October 15, 1890.
Newport News, Va., Superintendent of Newport News Gas
Company.
- Bowes, M. October 20, 1897.
Raleigh N. C., Superintendent Raleigh Gas Company.
- Bradley, Fred L. October 16, 1889.
99th street and 2d avenue, New York, N. Y., Superintendent
of 99th and 111th street Stations Consolidated Gas Co.

- Bradley, William H. May 12, 1875.
4 Irving place, New York, N. Y., Chief Engineer of Consolidated Gas Co.
- Branch, A. H. October 19, 1892.
405 17th street, Denver, Col., P. O. Box 359, Treasurer and General Manager of Denver Consolidated Gas Co.
- Bredel, Frederick. October 21, 1885.
118 Farwell avenue, Milwaukee, Wis., P. O. Box 235, Gas Engineer and Contractor.
- Britton, John A. October 16, 1895.
N. W. cor. 13th and Clay streets, Oakland, Cal., Secretary and General Manager of Oakland Gas Light and Heat Co.
- Brown, Ernest C. October 19, 1887.
280 Broadway, New York, N. Y., Editor of "Progressive Age."
- Brown, Rezeau B. October 27, 1896.
Market street, Newark, N. J., Manager of Market Street Works, Newark Gas Co.
- Buckman, James. October 15, 1890.
S. E. cor. 8th and Green streets, Philadelphia, Pa., Manager Bristol Gas Light Co.
- Burke, James E. October 16, 1895
Princeton, N. J., P. O. Box 92, Secretary and Treasurer of Princeton Gas Light Co.
- Burrage, Albert C. October 20, 1897.
24 West street, Boston, Mass., President Boston, Roxbury, Dorchester, South Boston and Bay State (of Mass.) Gas Light Companies.
- Bush, John S. October 17, 1883.
1845 Vanderbilt avenue, New York, N. Y., President of Northern Gas Light Co., of New York City.
- Bush, Robert W. October 19, 1892.
12th street and Gowanus Canal, Brooklyn, N. Y., Engineer of Metropolitan Works, Brooklyn Union Gas Co.
- Butterworth, Irwin. October 16, 1889.
135 North Front street, Columbus, Ohio, 1st Vice-President and General Manager of the Columbus Gas Co.
- Byers, C. A. October 17, 1894.
Toledo, Ohio, Consulting Engineer of Bristol Gas Light Co.

- Byrne, Thomas E. October 18, 1882.
51 Montgomery place, Brooklyn, N. Y., Engineer of the Citizens Works, Brooklyn Union Gas Co.
- Cabot, George D. May 13, 1874.
Lawrence, Mass., P. O. Box 205.
- Cabot, John. October 19, 1884.
553 West 33d street, New York, N. Y., Manufacturer of Trays for Gas Works.
- Callahan, W. P. October 19, 1881.
901 East 3d street, Dayton, Ohio, Director of Dayton Gas Light and Coke Co.
- Callender, Elbert P. October 17, 1894.
32 Pine street, New York, N. Y., Editor of American Gas Light Journal.
- Capelle, George S. October 19, 1887.
827 Market street, Wilmington, Del., Vice-President of Wilmington Coal Gas Co.
- Cardall, J. H. October 18, 1893.
Cor. Main and Mill streets, Memphis, Tenn., Superintendent of New Memphis Gas Co.
- Carpender, William. October 27, 1896.
32 Pine street, New York, N. Y., President East Chester (N.Y.) Gas Light Co.
- Carroll, Francis. October 16, 1889.
1643 Perdido street, New Orleans, La., P. O. Box 171, Manager and Engineer of Works of New Orleans Gas Light Co.
- Cartwright, William. April 16, 1873.
3413 Baring street, Philadelphia, Pa.
- Cathels, Edmund. October 27, 1896.
Hamilton, Ont., Superintendent and Engineer of Hamilton Gas Light Co.
- Chambers, John S. October 16, 1873.
193 Brunswick avenue, Trenton, N. J., P. O. Box 217, General Manager and Treasurer of Trenton Gas Light Co.
- Chollar, Byron E. October 17, 1888.
411 North 11th street, St. Louis, Mo., Engineer of Laclede Gas Light Co.
- Clark, Walton. October 15, 1884.
813 Drexel Building, Philadelphia, Pa., General Superintendent of the United Gas Impt. Co.

- Clarke, George S. October 17, 1888.
N. E. cor. 9th and Central streets, Kansas City, Mo., Superintendent of Kansas City, Missouri, Gas Company.
- Clary, Edward D. October 21, 1891.
911 North 6th street, Burlington, Iowa, Secretary and Superintendent of Burlington Gas Light Co.
- Coates, John R. October 17, 1894.
23 Sparks street, Ottawa, Ont., President and Engineer of Ottawa Gas Co.
- Cocke, J. T. October 20, 1897.
Bowdoin, Athens, Ga., President Athens Gas Light Company.
- Coffin, John A. October 20, 1886.
Duncan street, Gloucester, Mass., Superintendent and Agent of Gloucester Gas Light Co.
- Coggshall, H. F. May 13, 1874.
316 Main street, Fitchburg, Mass., P. O. Box 633, General Manager and Treasurer of Fitchburg Gas and Electric Light Co.
- Collins, Charles R. October 15, 1890.
216 Cherry street, Seattle, Wash., General Manager of Seattle Gas and Electric Light Company.
- Colins, John. October 21, 1891.
1 Mt. William street, Port Jervis, N. Y., P. O. Box 972, Superintendent of Port Jervis Gas Co.
- Corbett, Charles H. October 18, 1882.
428 Lafayette avenue, Brooklyn, N. Y., P. O. Station G, Vice-President of Continental Iron Works.
- Cosgrove, W. L. October 20, 1886.
Alabama and Broad streets, Atlanta, Ga., P. O. Box 311, Chief Clerk of Atlanta Gas Light Co.
- Cowdery, Edward G. October 21, 1885.
Milwaukee and Michigan streets, Milwaukee, Wis., General Manager of Milwaukee Gas Light Co.
- Cowing, John H. April 16, 1873.
11 E. Seneca street, Buffalo, N. Y., Vice-President and Treasurer of Buffalo Mutual Gas Light Co.
- Coyle, Patrick. October 19, 1881.
27 Arlington avenue, Charlestown, Mass., General Superintendent of Charlestown Gas and Electric Co.

- Crafts, David W. October 20, 1875.
116 Main street, Northampton, Mass., P. O. Box 93, Superintendent of Northampton Gas Light Co.
- Cressler, Alfred D. October 18, 1882.
Calhone and Murray streets, Fort Wayne, Ind., President of Kerr-Murray Manufacturing Co.
- Crisfield, James A. P. October 15, 1890.
7 Congress street, West, Savannah, Ga., P. O. Box 315, Superintendent of Mutual Gas Light Co.
- Crockett, Joseph B. October 17, 1883.
415 Post street, San Francisco, Cal., President and Engineer of San Francisco Gas and Electric Co.
- Croul, Jerome. October 21, 1891.
Lewis Block, Room 4, Detroit, Mich., Trustee of Detroit Gas Light Co.
- Curley, Thomas. October 15, 1879.
827 Market street, Wilmington, Del., Superintendent of Wilmington Coal Gas Co.
- Curtis, Samuel Philip. October 20, 1897.
26 Front street. Newark, N. J., Works Manager at Front street Station, The Newark Gas Company.
- Daly, David R. October 21, 1885.
Green and Essex streets, Jersey City, N. J., Vice-President and Treasurer of J. H. Gautier & Co.
- Daniels John M. October 15, 1890.
1344 Main street, Columbia, S. C., P. O. Box 152, Superintendent and Agent of the U. G. I. Co. for Columbia Gas Light Co.
- Davis, Fred. J. October 20, 1875.
74 Montgomery street, Boston, Mass., P. O. Box 1297, Constructing Engineer of Davis & Farnham Mfg. Co., Waltham, Mass.
- Dell, John. October 21, 1885.
901 Pine street, St. Louis, Mo., Traveling Agent of Laclede Fire Brick Manufacturing Co.
- Diall, M. N. October 18, 1876.
507 Ohio street, Terre Haute, Ind., Gen'l Manager of Citizens Gas and Fuel Co.
- Dickey, Charles H. October 17, 1883.
North and Saratoga streets, Baltimore, Md., P. O. Box 773, Gen'l Manager Maryland Meter and Mfg. Co.

- Dickey, Robert R. October 19, 1881.
Cor. Main and 2d streets, Dayton, Ohio, President of Dayton Gas Light and Coke Co.
- Dingee, F. A. October 18, 1882.
720 Reading Terminal, Philadelphia, Pa., President of Pennsylvania Gas Coal Co.
- Dixon, J. Alfred. October 19, 1892.
160 Broadway, New York, N. Y., Engineer of Pintsch Compressing Co.
- Dixon, Robert M. October 15, 1890.
160 Broadway, New York, N. Y., Manager of Pintsch Compressing Co.
- Doherty, Henry L. October 27, 1896.
Madison, Wis., General Manager of Madison Gas and Electric Co.
- Dole, Walter S. October 27, 1896.
22d street and Center avenue, Chicago, Ills., Superintendent of People's Gas Light and Coke Company.
- Doty, Paul. October 27, 1896.
168 Broadway, Long Branch, N. J., P. O. Box 157, General Manager of Consolidated Gas Co. of New Jersey.
- Douglas, David. October 17, 1888.
Eau Claire, Wis.
- Douglas, Henry W. October 21, 1891.
107 South 5th avenue, Ann Arbor, Mich., General Manager of Ann Arbor Gas Co.
- Dunbar, Carl H. October 18, 1893.
Elgin, Ill., P. O. Box 1987, Manager of Elgin American Gas Co.
- Dunbar, James W. October 17, 1894.
Sycamore and 7th streets, New Albany, Ind., Superintendent of New Albany Gas Light and Coke Co.
- Eakin, John W. October 17, 1894.
709 Levee street, Cairo, Ill., Secretary and Superintendent of Cairo City Gas Co.
- Edwards, George B. October 18, 1882.
113 Chambers street, New York, N. Y., Agent of Goodwin Meter Co.
- Egner, Frederick. October 16, 1889.
26 Hamilton avenue, Norfolk, Va., Consulting Engineer.

- Eichbaum, Frederick H. October 16, 1889.
2644 Howard street, San Francisco, Cal., Engineer and Superintendent of Pacific Gas Impt. Co.
- Eilbeck, Arthur B. October 16, 1895.
Drexel Building, Philadelphia, Pa., General Manager Welsbach Commercial Co.
- Elkins, George W. October 20, 1886.
423 Walnut street, Philadelphia, Pa., Manufacturer of Coal Tar Products.
- Elkins, William L., Jr. October 23, 1886.
606 Bourse Building, Philadelphia, Pa., President of Philadelphia Gas Impt. Co.
- Elliott, Walter P. October 16, 1895.
No address.
- Evans, Charles H. October 16, 1889.
4133 Cottage Grove avenue, Chicago, Ill., Engineer and General Superintendent of Mutual Fuel Gas Co.
- Faben, Charles R., Jr. October 21, 1885.
327 South Erie street, Toledo, Ohio, General Manager of Toledo Gas Light and Coke Company.
- Faux, J. A. October 16, 1895.
St. John, N. B., c/o Gas Department, St. John Railway Co.
- Fay, William J. October 15, 1884.
Anaheim, Cal.
- Ferrier, James. October 16, 1895.
315 12th street, Columbus, Ga., P. O. Box 372, Superintendent of the Gas Light Co. of Columbus.
- Findlay, J. H. October 18, 1882.
17 Franklin street, Ogdensburg, N. Y., Manager of Ogdensburg Gas Works.
- Fitz, Robert F. October 15, 1890.
253 Broadway, New York, N. Y., P. O. Box 933, Treasurer of Standard General Supply Co.
- Flemming, Dudley D. October 13, 1880.
249 Washington street, Jersey City, N. J., Gas Engineer.
- Floyd, Frederick W. October 18, 1882.
539 West 20th street, New York, N. Y., firm of James R. Floyd's Sons.

- Floyd, Henry E. October 18, 1882.
539 West 20th street, New York, N. Y., firm of James R. Floyd's Sons.
- Floyd, James R. April 16, 1873.
539 West 20th street, New York, N. Y.
- Fodell, William P. October 15, 1879.
50 Laurel street, Philadelphia, Pa., Secretary and Treasurer of Northern Liberties Gas Co.
- Fogarty, Thomas B. October 19, 1881.
49 9th avenue, Newark, N. J.
- Forbes, James. October 16, 1889.
619 Cherry street, Chattanooga, Tenn., Superintendent of Chattanooga Gas Light Co.
- Forstall, Alfred E. October 17, 1888.
Montclair, N. J., General Manager of Montclair Gas and Water Company.
- Forstall, Walton. October 16, 1895.
Transit and Lagrange streets, Lockport, N. Y., Superintendent of Lockport Gas and Electric Light Co.
- Foss, Eugene N. October 19, 1892.
8 Everett street, Jamaica Plain, Mass., President of Jamaica Plain Gas Light Co.
- Fowler, John. October 15, 1879.
39 Laurel street, Philadelphia, Pa., Deily & Fowler, Laurel Iron Works.
- Fowler, Samuel J. October 21, 1891.
Springfield, Mass., P. O. Box 1536, General Manager Springfield Gas Light Co.
- Frost, William H. October 15, 1879.
11 East Wall street, Fort Scott, Kan., P. O. Box 463, President and General Manager of Fort Scott Light and Fuel Co.
- Fry, Charles C. October 17, 1883.
90 Exchange street, Lynn, Mass., Treasurer of Lynn Gas and Electric Co.
- Gandey, A. C. October 21, 1891.
31 Bridge street, Lambertville, N. J., P. O. Box 217, Superintendent of Lambertville Gas Light Co.
- Gardner, James, Jr. October 17, 1883.
Conestoga building, Room 34, Pittsburg, Pa., P. O. Box 373, Manufacturer of Retorts and Fire Brick.

- Gardner, William. May 12, 1875.
Conestoga building, Room 34, Pittsburg, Pa., P. O. Box 373,
Gas Engineer.
- Gartley, William H. October 21, 1885.
Richmond and Tioga streets, Philadelphia, Pa., Engineer and
Superintendent of Philadelphia Gas Impt. Co.
- Gates, Frederick W. May 13, 1874.
17 Herkimer street, Hamilton, Ont., Can., President of Ham-
ilton Gas Light Co.
- Geggie, David H. October 19, 1881.
No. 2 Place d'Orleans, Quebec, Canada, P. O. Drawer 1120,
Secretary and Manager of the Quebec Gas Co.
- Gerould, Charles L. October 17, 1883.
North Third and Prospect avenues, Mt. Vernon. N. Y., Super-
intendent of the East Chester Gas Light Co.
- Gibbons, P. H. October 18, 1893.
407 Chestnut street, Coatesville, Pa., P. O. Box 108, Superin-
tendent of Coatesville Gas Co.
- Gibbs, W. W. October 20, 1886.
813 Drexel building, Philadelphia, Pa., Chairman of Man-
aging Committee, The United Gas Improvement Co.
- Giblin, John A. October 21, 1891.
8 East Main street, Ilion, Herkimer Co., N. Y., P. O. Box
513, Manager of Ilion and Mohawk Gas Light Co.
- Gifford, Nathaniel W. October 21, 1891.
New Bedford, Mass., Superintendent of New Bedford Gas and
Edison Light Co.
- Gimper, John. October 15, 1890.
32d and Market streets, Galveston, Texas, Superintendent of
Galveston Gas Co.
- Glasgow, Arthur G. October 19, 1887.
9 Victoria street, London, S. W., England, Humphreys &
Glasgow, London and New York.
- Glass, Sheldon J. Oct. 20, 1897.
Montgomery building, Milwaukee, Wis., Secretary and Treas-
urer Milwaukee Gas Light Company.
- Goodwin, W. W. April 16, 1873.
532 Bourse Building, Philadelphia, Pa., President of Goodwin
Meter Co.

- Graeff, George W., Jr. October 17, 1883.
Philadelphia, Pa.
- Graf, Carl H. October 19, 1892.
Lawrence, Mass., P. O. Box K, Superintendent of Gas Department, Lawrence Gas Co.
- Graves, Henry C. October 17, 1883.
Cor. Main and 2d streets, Dayton, Ohio, Vice President of Dayton Gas Light and Coke Co.
- Green, James. October 21, 1885.
901 Pine street, St. Louis, Mo., President of Sedalia Gas Co., Moberly Gas and Electric Co., and Greencastle Gas and Electric Light Co.
- Greenough, Malcolm S. October 16, 1878.
356 Superior street, Cleveland, Ohio, President Cleveland Gas Light and Coke Co.
- Gribbel, John. October 17, 1883.
1513 Race street, Philadelphia, Pa., of John J. Griffin & Co., Meter Manufacturers.
- Guldlin, Olaf N. October 21, 1891.
11 Webster street, Fort Wayne, Ind., President and Engineer of Western Gas Construction Co.
- Gwynn, J. W. October 15, 1890.
Bucyrus, Ohio, P. O. Box 1092, Superintendent of Bucyrus Gas Light and Fuel Co.
- Hambleton, Francis H. October 17, 1888.
19 South street, Baltimore, Md., P. O. Box 288, Chief Engineer of Consolidated Gas Co
- Hammatt, Clarence S. October 15, 1890.
26 Main street, Jacksonville, Fla., Superintendent of Citizens Gas and Electric Co.
- Hanford, L. C. May 13, 1874.
1 Belden avenue, Norwalk, Conn., P. O. Box 402, Superintendent of Norwalk Gas Light Co.
- Harbison, John P. May 13, 1874.
Hartford, Conn., Treasurer and General Manager Hartford City Gas Light Co.
- Harper, George H. October 16, 1889.
2526 Broad avenue, Altoona, Pa., Superintendent Altoona Gas Co.

- Harris, J. A. October 20, 1886.
1513 Race street, Philadelphia, Pa., with J. J. Griffin & Co.,
Gas Meter Manufacturers.
- Hatstat, John W. October 27, 1896.
Hartford, Conn., Superintendent of Hartford City Gas Light
Co.
- Hauk, Charles D. October 21, 1885.
138 South 6th street, Philadelphia, Pa., Vice President and
General Manager of National Heat and Power Construction
Co.
- Hayward, Thomas J. October 15, 1884.
McHenry and Scott streets, Baltimore, Md., Bartlett, Hayward
& Co., Engineers and Contractors.
- Helme, William E. October 20, 1886.
1339 Cherry street, Philadelphia, Pa., Helme & McIlhenny,
Meter Manufacturers.
- Herron, J. T. October 15, 1890.
293 Court street, Buffalo, N. Y., Superintendent of the Citizens
Gas Co.
- Hickenlooper, Andrew. May 13, 1874.
838 Dayton street, Cincinnati, Ohio, P. O. Box 719, President
of Cincinnati Gas Light and Coke Co.
- Hicks, Richard S. October 17, 1894.
73 Warren street, New York, N. Y.
- Higby, William R. October 18, 1888.
380 Main street, Bridgeport, Conn., President of Bridgeport
Gas Light Co.
- Hill William H. October 19, 1892.
40 Water street, Boston, Mass., Lock Box 185, President of
Citizens Gas Light Co., Quincy, Mass.
- Holden, Thos. F. October 20, 1897.
12th and M Streets, S. E., Washington, D. C., Superintendent
East Station Works, Washington Gas Light Company.
- Holzer, Edwin G. October 17, 1894.
204 Terry Building, Roanoke, Va., P. O. Drawer 12, Superin-
tendent of Gas Department, Roanoke Gas and Water Co.
- Hookey, George S. May 13 1874.
303 Centre street, Augusta, Ga.

- Hopper, William H. October 18, 1882.
131 West Walnut lane, Germantown, Philadelphia, Pa., Director in Warsaw Gas Light Co., Wis.
- Hostetter, D. Herbert. October 16, 1889.
59 Water street, Pittsburg, Pa., P. O. Box 835, President of Pittsburg Gas Co.
- Hough, David Leavitt. October 19, 1892.
117 West 58th street, New York, N. Y., Consulting Engineer and Contractor.
- Humphreys, Alexander C. Oct. 20, 1875.
31 Nassau street, New York, N. Y., Humphreys & Glasgow, Gas Engineers, New York and London; President Syracuse Gas Co., &c.
- Humphreys, C. J. R. October 19, 1881.
256 Essex street, Lawrence, Mass., P. O. Box K, Agent of Lawrence Gas Co.
- Hyde, Gustavus A. October 18, 1882.
85 Kennard street, Cleveland, Ohio, Engineer of Cleveland Gas Light and Coke Co.
- Isbell, Charles W. May 12, 1875.
245 Broadway, New York, N. Y., President of Isbell-Porter Co., Gas Engineers and Contractors.
- Jackson, Walter M. October 19, 1887.
(9 Oliver street, Stamford, Conn.) New York, N. Y., P. O. Box 808.
- Jenkins, E. H. Oct. 21, 1891.
68 East 7th street, Covington, Ky., Engineer and Superintendent of Covington Gas Light Co.
- Jenks, Zeuner M. October 16, 1895.
169 Main street, Woonsocket, R. I., Superintendent of Woonsocket Gas Co.
- Jones, Edward C. October 15, 1879.
415 Post street, San Francisco, Cal., Assistant Engineer of San Francisco Gas and Electric Co.
- Jourdan, James H. October 21, 1891.
Nevins and Degraw streets, Brooklyn, N. Y., Chief Engineer of Western Division Brooklyn Union Gas Co.

- Judson, Charles E. October 17, 1883.
148 Michigan avenue, Chicago, Ill., President and Engineer
Chicago Economic Fuel Gas Co.
- Kellogg, L. L. October 15, 1890.
518 5th street, Sioux City, Iowa, Superintendent of Sioux City
Gas Light Co.
- Kelly, H. H. October 19, 1892.
49 Chestnut street, Chelsea, Mass., Superintendent of Chelsea
Gas Light Co.
- Keppelman, John H. October 21, 1891.
144 North 4th street, Reading, Pa., P. O. Box 384, Superin-
tendent of the Consumers' Gas Co.
- Kingsbury, Frank D. May 13, 1874.
8 East Market street, Corning, N. Y., P. O. Box 884, Treasurer
and General Manager of Corning Gas Co.
- Kipp, Leonard P. October 20, 1897.
Sing Sing, N. Y., Secretary Sing Sing Gas Manufacturing Co.
- Knight, Elmer B. October 21, 1891.
Far Rockaway, Long Island, N. Y., P. O. Box 331, Superin-
tendent of the Town of Hempstead Gas and Electric Light Co.
- Knowles, W. P. October 27, 1896.
Richmond, Va., Superintendent of City Gas Works.
- Kreischer, George F. October 21, 1885.
119 East 23d street, New York, N. Y., President of B. Kreischer
& Sons, Gas Retort Manufacturers.
- Krumholz, Joseph. October 19, 1887.
249 West Genesee street, Buffalo, N. Y., Secretary and Gen-
eral Manager of Buffalo Gas Light Co.
- Kuehn, Jacob L. October 19, 1881.
33 East Philadelphia street, York, Pa., P. O. Box 344, Superin-
tendent and Engineer of York Gas Co.
- Lamson, Charles D. October 19, 1881.
33 Pearl street, Worcester, Mass., President and General Man-
ager of Worcester Gas Light Co.
- Lane, James W. October 21, 1891.
Mount Vernon, N. Y., Eastchester Gas Light Co.
- Langford, John T. October 17, 1883.
70 Kilby street, Boston, Mass., Contracting Engineer.
- Lansden, Thomas G. October 21, 1885.
206 A street S. W., Washington, D. C.

- Leach, Henry B. October 18, 1882.
21 Franklin street, Taunton, Mass., P. O. Box 841, Agent and
Treasurer of Taunton Gas Light Co.
- Learned, Charles A. October 27, 1896.
47 Washington street, Meriden, Conn., P. O. Box 1375, Super-
intendent and Manager of Meriden Gas Light Co.
- Learned, Everett C. October 19, 1881.
118 Maple street, New Britain, Conn., P. O. Box 355, Super-
intendent of New Britain, Gas Light Co.
- Learned, Waldo A. October 18, 1882.
2 Jewett street, Newton, Mass., P. O. Box 14, General Super-
intendent of Newton and Watertown Gas Light Co.
- Lee, Edward C. October 20, 1886.
813 Drexel Building, Philadelphia, Pa., Secretary and Treas-
urer of The United Gas Improvement Co. and Welsbach
Light Co.
- Leetch, John. October 17, 1894.
1409 31st street, Washington, D. C., General Manager of
Washington Gas Light Co.
- Light, Joseph. October 21, 1885.
203 East First street, Dayton, Ohio, Superintendent of Dayton
Gas Light and Coke Co.
- Lillie, Lewis. October 21, 1891.
813 Drexel Building, Philadelphia, Pa., Comptroller of the
United Gas Improvement Co.
- Little, F. W. October 20, 1897.
223 East Market street, Akron, Ohio, Vice-President and
General Manager The Akron Gas Company.
- Littlehales, Thomas. May 13, 1874.
1 Durston Memorial Building, Syracuse, N. Y., General Man-
ager of Syracuse Gas Co.
- Littleton, Augustus W. October 16, 1889.
111 South 5th street, Quincy, Ill., Secretary and Superintendent
of Quincy Gas Light and Coke Co.
- Lloyd, John. October 27, 1896.
First National Bank, Altoona, Pa., President of Altoona Gas
Co.
- Logan, John D. October 18, 1893.
Brooklyn, E. D., N. Y., P. O. Box 6, Station G, Vice President
of Greenpoint Gas Light Co.

- Logan, William J. October 19, 1892.
Brooklyn, E. D., N. Y., P. O. Box 6, Station G, Proprietor of
Logan Iron Works.
- Loomis, Burdett. October 15, 1884.
Hartford, Conn., Builder of Water Gas Works.
- Lowe, Thaddeus S. C. October 20, 1886.
Pasadena, Cal., President of Pasadena Gas and Electric Light
Co.
- Ludlam, Edwin. October 15, 1873.
180 Remsen street, Brooklyn, N. Y., P. O. Box 76, Secretary of
Brooklyn Union Gas Co.
- Lynch, Eugene T. October 16, 1895.
Detroit, Mich., President of Detroit Gas Co.
- Lynn, James T. October 17, 1883.
717 Trumbull avenue, Detroit, Mich., Superintendent of Distri-
bution of Detroit Gas Co.
- Macdonald, Benjamin J. October 15, 1890.
70 Water street, Newburg, N. Y., P. O. Box 94, Secretary and
Treasurer of Consumers' Gas Co.
- MacDonald, William. October 16, 1889.
36th Ward Gas Works, Philadelphia, Pa., Superintendent
of Point Breeze Gas Works.
- MacMillan, George. October 21, 1891.
565 Oneida street, Appleton, Wis., P. O. Box 1206, President
and Treasurer of Appleton Gas Light and Fuel Co., of Apple-
ton, Wis.
- Mactier, Henry. October 15, 1890.
Asheville, N. C., Consulting Engineer.
- Marani, Virgil G. October 20, 1897.
356 Superior street, Cleveland, Ohio, Assistant Engineer
Cleveland Gas Light and Coke Company.
- Max, William J. October 20, 1897.
13 William street, Middletown, N. Y., Superintendent Middle-
town Gas and Electric Light Company.
- Mayer, Frederick T. October 15, 1884.
McHenry and Scott streets, Baltimore, Md., Engineer with
Bartlett, Hayward & Co.

- McCleary, Alexander J. October 17, 1888.
23d and Market streets, Philadelphia, Pa., Assistant to Chief
of Bureau of Gas, Dept. of Public Works.
- McCullough, Edmund H. October 18, 1882.
224 South 3d street, Philadelphia, Pa., President of West-
moreland Coal Co.
- McDonald, William. October 15, 1879.
51 Lancaster street, Albany, N. Y., Secretary and Treasurer
of Bath Gas Co., Bath, N. Y.
- McElroy, John H. May 13, 1874.
435 Sixth avenue, Pittsburg, Pa., P. O. Box 835, Engineer
of Pittsburg Gas Co.
- McIlhenny, James S. October 15, 1890.
26th and G streets, N. W., Washington, D. C., Superintendent
of Washington Gas Light Co.
- McIlhenny, John. May 12, 1875.
1339 Cherry street, Philadelphia, Pa., Helme & McIlhenny,
Meter Manufacturers.
- McIlhenny, John D. October 16, 1895.
1339 Cherry street, Philadelphia, Pa., President of Citizens
Gas and Fuel Co., Terre Haute, Ind.
- McKay, William E. October 19, 1892.
10 Pearl street, Dorchester, Mass., Assistant Engineer of Bay
State Gas Co. and Boston Gas Light Co.
- McKeige, Ferdinand. October 15, 1890.
31 Nassau street, New York, N. Y., Secretary and Treasurer
of Standard Gas Light Co.
- McLean, John R. October 17, 1894.
413 10th street, N. W., Washington, D. C., President of Wash-
ington Gas Light Co.
- McMillin, Emerson. May 13, 1874.
40 Wall street, New York, N. Y., President of Columbus Gas
Light and Coke Co.; Laclede Gas Co.; Milwaukee Gas Co.;
Grand Rapids Gas Co., and Consolidated Gas Co., of New
Jersey, &c.
- Merritt, Charles H. October 15, 1879.
350 Main street, Danbury, Conn., P. O. Box B, President
of Danbury and Bethel Gas and Electric Light Co.

- Middleton, Robert L. October 17, 1894.
1333 30th street, N. W., Washington, D. C., Superintendent
of Georgetown Gas Light Co.
- Miller, Alten S. October 16, 1889.
Long Island City, N. Y., Chief Engineer of East River Gas
Co.
- Miller, C. O. G. October 21, 1891.
Cor. Annie and Stevenson streets, San Francisco, Cal., Treas-
urer of Pacific Gas Improvement Co., also Secretary and
Treasurer of Pacific Lighting Co.
- Miller, William A. October 27, 1896.
2817 Eastern avenue, Cincinnati, Ohio, Superintendent of
Manufacture, Cincinnati Gas Light Co.
- Milsted, William N. October 19, 1887.
512 West 22d street, New York, N. Y., Secretary of American
Meter Co.
- Mitchell, Kerr M. October 16, 1889.
516 Francis street, St. Joseph, Mo., General Manager of St.
Joseph Gas Co.
- Moore, David. October 19, 1881.
110 Federal street, Salem, Mass., P. O. Box 298.
- Morgans, William H. October 19, 1887.
36 Wessen street, Pontiac, Mich., Superintendent of L. R.
Medbury Gas Works.
- Morrell, Edward E. October 20, 1897.
Oak Park, Ills, Vice-President and Engineer Cicero Gas Co.
- Morris, Henry G. October 15, 1879.
926 Drexel building, Philadelphia, Pa., Engineer and Ma-
chinist.
- Morton, Fred. N. October 16, 1895.
Willow avenue, and 13th street, Hoboken, N. J., Superintend-
ent of Hudson County Gas Light Co.
- Moses, Frank D. October 17, 1894.
111 Lake street, Chicago, Ill., Engineer and Contractor.
- Moses, George W. October 13, 1880.
187 Winnisimmet street, Chelsea, Mass., Treasurer of Chelsea
Gas Light Co.

- Nash, Abner F. October 21, 1891.
Windsor, Ont., Secretary, Treasurer and Manager of the Windsor Gas Co.
- Neal, George B. May 13, 1874.
Thompson square, Charlestown, Mass., Treasurer and General Manager of Charlestown Gas and Electric Co.
- Nettleton, Charles H. October 20, 1875.
22 Elizabeth street, Derby, Conn., P. O. Drawer L, Treasurer and Agent of Derby Gas Co.
- Nix, Joshua J. October 16, 1895.
353 Church street, Royersford, Pa., P. O. Box 158, Lessee of Spring City and Royersford Gas Light Co.
- Norcross, J. A. October 27, 1896.
9 Victoria street, London, S. W., England, Manufacturing Expert, Humphreys and Glasgow.
- Norris, Rollin. October 16, 1889.
813 Drexel Building, Philadelphia, Pa., Inspector of Works of The United Gas Improvement Co.
- Nute, Joseph E. October 17, 1888.
14 Bedford street, Fall River, Mass., P. O. Box 66, Superintendent of Fall River Gas Works Co.
- Page, Carter H., Jr. October 18, 1893.
813 Drexel Building, Philadelphia, Pa., Gas Engineer with the United Gas Improvement Co.
- Page, F. D. October 27, 1896.
316 Main street, Fitchburg, Mass., P. O. Box 575, Asst. Superintendent of Fitchburg Gas and Electric Light Co.
- Park, William K. October 21, 1885.
Juniper and Filbert streets, Philadelphia, Pa., Chief of Bureau of Gas, Department of Public Works.
- Payne, Milton J. October 21, 1885.
10th and Walnut streets, Kansas City, Mo., President of Kansas City, Missouri, Gas Co.
- Pearson, William H. October 20, 1875.
19 Toronto street, Toronto, Ont., General Manager and Secretary of Consumers' Gas Co.
- Pearson, William H., Jr. October 17, 1888.
95 Isabella street, Toronto, Ont., Engineer and Superintendent of Consumers' Gas Co.

- Perkins, James D. October 18, 1882.
228 Produce Exchange, New York, N. Y., Perkins & Co., Gas Coal Dealers.
- Pierson, Henry M. October 19, 1892.
114 Broad street, New York, N. Y., Consulting Engineer of Plattsburg Light, Heat and Power Co.
- Pinkney, Edward A. October 21, 1891.
29 Whitesboro street, Utica, N. Y., General Manager and Engineer of Equitable Gas and Electric Co.
- Poor, Frank B. October 27, 1896.
Hackensack, N. J., President of Hackensack Gas & Electric Light Co.
- Porter, J. F. October 27, 1896.
205 Market street, Alton, Ills., President of Alton Gas & Electric Co.
- Pratt, Edward G. October 20, 1886.
208 5th street, Des Moines, Iowa, Manager of Capital City Gas Light Co.
- Prichard, Charles F. October 17, 1883.
90 Exchange street, Lynn, Mass., General Superintendent of Lynn Gas and Electric Co.
- Printz, Eugene. May 13, 1874.
188 North 5th street, Zanesville, Ohio, Superintendent of Zanesville Gas Light Co.
- Proctor, William L. October 21, 1891.
62 Washington street, Ogdensburg, N. Y., President of Ogdensburg Gas Co.
- Quinn, Andrew K. October 19, 1887.
181 Thames street, Newport, R. I., P. O. Box 305, Treasurer of Newport Gas Light Co.
- Ramsdell, George G. October 15, 1879.
222 South 3d street, Philadelphia, Pa., General Manager of American Gas Co.
- Rathell, Walter S. October 18, 1893.
230 N. Main street, Decatur, Ills., Superintendent and Purchasing Agent for Decatur Light, Heat and Power Co.
- Rawn, John C. October 21, 1891.
Roanoke, Va., P. O. Drawer 749, Manager and Engineer of Roanoke Gas and Water Co.

- Raynor, Charles H. October 15, 1873.
11 North Winter street, Adrian, Mich., Secretary of Adrian Gas Co.
- Reichelt, A. F. October 20, 1897.
350 Alexander avenue, New York City, Secretary and Treasurer Central Union Gas Co.
- Reilly, John W. October 21, 1891.
116 South 6th street, Wilmington, N. C., Superintendent of Wilmington Gas Light Co.
- Rice, Harry L. October 17, 1894.
Norfolk, Va., Superintendent City Gas Co. of Norfolk.
- Richardson, Frank S. October 19, 1881.
9 Elmwood avenue, North Adams, Mass., P. O. Box 853, Vice-President, Treasurer and Manager of North Adams Gas Light Co.
- Ridgely, William. October 21, 1885.
Springfield, Ill., President of Springfield Gas Light Co.
- Ringwood, Thomas. October 15, 1890.
4 Armory street, Ilion, Herkimer County, N. Y., P. O. Box 1023, President of Ilion and Mohawk Gas Light Co.
- Roberts, George J. October 17, 1894.
813 Drexel Building, Philadelphia, Pa., Gas Engineer with the United Gas Improvement Co.
- Rogers, W. H. October 17, 1894.
146 Ellison street, Paterson, N. J., P. O. Box 408, Agent of the United Gas Improvement Co.
- Roots, D. T. October 17, 1883.
Connersville, Ind., President of P. H. & F. M. Roots Co., Exhauster Manufacturers.
- Ross, Alexander. October 27, 1896.
411 North 11th street, St. Louis, Mo., Secretary and General Manager of Laclede Gas Light Co.
- Rowland, Charles L. October 17, 1888.
61 Morton street, Brooklyn, N. Y., Consulting Engineer of Williamsburg Gas Light Co.
- Rowland, Thomas F. May 13, 1874.
329 Madison avenue, New York, N. Y., President of the Continental Iron Works, Brooklyn, N. Y.

- Rowland, Thomas F., Jr. October 19, 1881.
170 Keep street, Brooklyn, N. Y., P. O. Station G, Secretary and Treasurer of Continental Iron Works.
- Rowland, William L. October 20, 1886.
4800 Chester avenue, Philadelphia, Pa., Superintendent of Ammonia Co. of Philadelphia.
- Rusby, John M. October 17, 1888.
109 Montgomery street, Jersey City, N. J., P. O. Drawer R, Superintendent of the United Gas Impt. Co., Jersey City Works.
- Russell, Daniel R. October 19, 1887.
417 Pine street, St. Louis, Mo., Vice-President of Parker-Russell Mining and Manufacturing Co.
- Russell, Henry Z. October 17, 1894.
Honesdale, Pa., Secretary and Treasurer of Honesdale Gas Co.
- Schniewind, F. October 27, 1896.
311 Lewis Block, Pittsburg, Pa., Superintendent of United Coke & Gas Co.
- Scrafford, William H. October 19, 1887.
Bath, N. Y., P. O. Box 93, Superintendent of Bath Gas Co.
- Searle, Robert M. October 15, 1890.
Broad and Alabama streets, Atlanta, Ga., Superintendent of Atlanta Gas Light Co.
- Seaverns, F. October 17, 1883.
228 Produce Exchange, New York, N. Y., Treasurer of Perkins & Co., Coal Dealers.
- Serrill, William J. October 21, 1891.
813 Drexel Building, Philadelphia, Pa., Engineer of Allentown Gas Co., Allentown, Pa.
- Shelton, Frederick H. October 17, 1888.
524 Drexel Building, Philadelphia, Pa.; Welsbach Commercial Co.
- Sherman, F. C. October 20, 1875.
80 Crown street, New Haven, Conn., P. O. Drawer 3, Superintendent of New Haven Gas Light Co.
- Sisson, Frank N. October 20, 1886.
139 Lancaster street, Albany, N. Y.

- Slade, Clefford L. October 20, 1897.
Port Chester, N. Y., Superintendent Westchester Gas and Electric Company, Port Chester, N. Y.
- Slade, James. October 17, 1883.
95 Woodworth avenue, Yonkers, N. Y., Superintendent of Yonkers Gas Light Co.
- Slade, Richmond E. October 19, 1892.
White Plains, N. Y., P. O. Box 393, Superintendent and Secretary of Citizens Gas and Electric Co.
- Slaney, Henry C. October 16, 1889.
466 6th street, Brooklyn, N. Y., Gas Engineer.
- Slater, A. B. October 15, 1873.
Rear 20 Market square, Providence, R. I., P. O. Drawer 1422, Treasurer, Secretary and General Manager of Providence Gas Co.
- Slater, A. B., Jr. October 18, 1888.
101 Public street, Providence, R. I., P. O. Box 1160 Gas Engineer with Providence Gas Co.
- Slater Howard C. October 27, 1896.
441 Cass street, Milwaukee, Wis., P. O. Box 423, Superintendent of Milwaukee Gas Light Co.
- Smallwood, James B. October 17, 1883.
1512 Linden avenue, Baltimore, Md., P. O. Box 773, of Maryland Meter and Manufacturing Co.
- Smedburg, James R. October 18, 1882.
52 Lake street, Chicago, Ill., with Globe Light and Heat Co.
- Smith, John W. October 20, 1886.
60 Laurel street, Philadelphia, Pa., Superintendent of Northern Liberties Gas Co.
- Smith, Marcus. May 13, 1874.
Welles Building. Public square, Wilkes-Barre, Pa., Secretary and Superintendent of Wilkes-Barre Gas Co.
- Smith, Robert A. C. October 17, 1883.
100 Broadway, American Surety Building, New York, N. Y.
- Smith, William H. October 21, 1891.
201 avenue D, Bayonne, N. J., P. O. Box 232, Superintendent of U. G. I. Co.
- Snow, William H. October 19, 1887.
338 Maple street, Holyoke, Mass., P. O. Box 552, Superintendent of Holyoke Gas Works.

- Somerville, James. October 20, 1875.
Cor. Penn and Louisiana streets, Indianapolis, Ind., Engineer
and Superintendent of Indianapolis Gas Co.
- Spangenberg, B. H. October 20, 1897.
St. Augustine, Fla., Superintendent St. Augustine Gas and
Electric Light Co.
- Spaulding, Charles F. October 16, 1878.
Warren avenue, Waltham, Mass., Superintendent of Waltham
Gas Light Co.
- Spaulding, Charles S. October 20, 1886.
Railroad street, Wakefield, Mass., Manager of Wakefield
Municipal Light Plant.
- Spaulding, William H. October 16, 1889.
98 Walnut street, Clinton, Mass., P. O. Box 1094, Superin-
tendent of Clinton Gas Light Co.
- Sprague, Charles H. October 18, 1882.
70 Kilby street, Boston, Mass., P. O. Box 3105.
- Stacey, James E. October 27, 1896.
39 Mill street, Cincinnati, Ohio, General Manager of Florence
(Ala.) Gas Co.
- Stacey, William. October 19, 1887.
39 Mill street, Cincinnati, Ohio, Vice-President of the Stacey
Manufacturing Co.
- Stanley, Ira N. May 12, 1875.
310 Washington avenue, Brooklyn, N. Y., Gas Engineer.
- Starr, James M. October 20, 1875.
10th and North D streets, Richmond, Ind., Vice-President
Light, Heat and Power Co.
- Steck, Henry. October 21, 1891.
631 Chestnut street, room 12, Philadelphia., Pa., President
of Hagerstown (Md.) Light and Heat Co.
- Stedman, William A. October 17, 1877.
785 Flatbush avenue, Brooklyn, N. Y., General Manager
of Flatbush Gas Co.
- Stevens, Levi, Jr. October 17, 1894.
39 Philimon street, Trenton, N. J., P. O. Box 440, Superin-
tendent Heat, Light and Power Co. of N. J.

- Stirzel, J. W. October 16, 1895.
3448 Frankford avenue, Philadelphia, Pa., Assistant Superintendent of Philadelphia Gas Improvement Co.
- Strecker, Alexander H. October 20, 1897.
Newark, N. J., Engineer and Superintendent of The Newark Gas Co.
- Stroud, Morris W. October 16, 1895.
222 South Third street, Philadelphia, Pa., Secretary and Treasurer of the American Gas Co.
- Summers, George F. October 20, 1897.
Hackensack, N. J., Superintendent of Gas Department, Hackensack Gas and Electric Co.
- Summers, Thomas W. October 19, 1892.
Hornellsville, N. Y., P. O. Box 326, Superintendent of the Hornell Gas Light Co.
- Taber, Robert B. October 19, 1881.
Boston, Mass., P. O. Box 3462, Gas and Electric Engineer.
- Taylor, George H. October 18, 1882.
209 Main street, Warren, Ohio, Secretary, Treasurer and Superintendent of Warren Gas Light Co.
- Thompson, G. Treadway. October 21, 1891.
40 Wall street, New York, N. Y., Assistant to E. McMillin, President Laclede Gas Light Co., etc.
- Thwing, Orrell O. October 16, 1895.
Main and Howard streets, St. Louis, Mo., Superintendent of Station B, Laclede Gas Light Co.
- Tobey, Franklin, Jr. October 19, 1892.
112 Jansen avenue, Kingston, N. Y., General Manager Kingston Electric Co.
- Tracey, John. October 21, 1891.
25 Market street, Poughkeepsie, N. Y., P. O. Box 476, Lessee of Poughkeepsie Gas Works.
- Turner, Thomas. May 13, 1874.
224 Calhoun street, Charleiton, S. C., P. O. Box 6, President and Superintendent of Charleston Gas Light Co.
- Vanderpool, Eugene. October 16, 1873.
757 Broad street, Newark, N. J.
- Voorhis, A. M. October 17, 1894.
Broadway, Nyack, N. Y., P. O. Box 114, President, Treasurer and Manager of Nyack Gas Light and Fuel Co.

- Walbridge, H. D. October 17, 1894.
111 Ottawa street, Grand Rapids, Mich., General Manager
of Grand Rapids Gas Light Co.
- Waldo, Charles S. October 20, 1886.
102 Milk street, Boston, Mass., P. O. Box 3436, Waldo Bros.,
Gas Retorts and General Supplies.
- Waldo, John A. October 19, 1887.
102 Milk street, Boston, Mass., P. O. Box 3436, Waldo Bros.,
Gas Retorts and General Supplies.
- Walker, James H. October 18, 1882.
249 27th street, Milwaukee, Wis., Gas Engineer, The Mil-
waukee Gas Stove Co.
- Walters, Anderson H. October 21, 1891.
420 Main street, Johnstown, Pa., Secretary and Superintendent
of Consumers Gas Co.
- Ward, William H. October 19, 1892.
228 Front street, Easton, Pa., Superintendent of Easton Gas
Co.
- Warmington, Daniel R. October 21, 1891.
412 Pearl street, Cleveland, Ohio, Superintendent and Engineer
of the Peoples Gas Light Co.
- Warmington, George H. May 13, 1874.
412 Pearl street, Cleveland, Ohio, President of the Peoples
Gas Light Co.
- Watson, Charles. October 19, 1881.
432 Federal street, Camden, N. J., Secretary and Treasurer
of Camden Gas Light Co.
- Watt, Anthony. October 21, 1891.
10th street and Central avenue, Connersville, Ind., P. O. Box
27, Superintendent of Connersville Gas and Electric Co.
- Weber, Adam. October 13, 1880.
633 East 15th street, New York, N. Y., Proprietor of Manhattan
Fire Brick and Enamelled Clay Retort Works.
- Weber, Oscar B. October 17, 1883.
633 East 15th street, New York, N. Y., Manager of Manhattan
Fire Brick and Enamelled Clay Retort Works.
- Wehner, Adolph F. October 17, 1894.
245 Broadway, New York, N. Y., Treasurer Summit (N. J.)
Gas Light Co., Secretary Isbell-Porter Co.

- Westcott, John T. October 18, 1893.
19 Abingdon street, Westminster, London, S. W., Eng.,
Manager of the Economical Gas Apparatus Construction Co.
- Wheeler, Fred. B. October 18, 1893.
168 Broadway, Long Branch, N. J., P. O. Box 259, Superin-
tendent of Consolidated Gas Co. of New Jersey.
- White, Clement A. May 13, 1874.
16 St. James Court, Louisville, Ky.
- White, Edward D. October 17, 1883.
265 Stuyvesant avenue, Brooklyn, N. Y., Vice-President of
Nassau Gas Light Co.
- White, Henry H. October 21, 1891.
Portsmouth, Va., P. O. Box 39, Superintendent of Portsmouth
Gas Co.
- White, Wm. Henry. April 16, 1873.
32 Pine street, New York, N. Y., Engineer and Contractor.
- Whitney, Henry C. October 21, 1891.
19 Anthony street, Watertown, N. Y., Secretary and Superin-
tendent of Watertown Gas Light Co.
- Whittier, Charles R. October 19, 1887.
306 11th avenue, New York, N. Y., President of Whittier
Elevator Co.
- Wilcox, John F. October 27, 1896.
311 Lewis Block, Pittsburg, Pa., Manager of United Coke and
Gas Co.
- Williams, E. H. October 17, 1888.
150 Grand street, Waterbury, Conn., P. O. Box 223, Agent
and Superintendent of the United Gas Impt. Co.
- Williams, W. L. October 15, 1890.
183 Tyler street, Paterson, N. J., Supt. of the U. G. I. Co. for
Paterson and Peoples Gas Light Co.
- Williamson, John. October 18, 1893.
2 East Madison street, Chicago, Ill., Assistant Engineer of
Chicago Gas Light and Coke Co.
- Wood, Austin C. April 16, 1873.
216 North West street, Syracuse, N. Y., President of Homer
and Cortland Gas Light Co.
- Wood, Walter. October 19, 1881.
400 Chestnut street, Philadelphia, Pa., P. O. Box 1935, of R.
D. Wood & Co., also Treasurer of Millville Gas Light Co.

- Wood, William A. October 16, 1889.
609 Commercial street, Boston, Mass., Assistant Engineer
of Boston Gas Light Co.
- Woodruff, Charles D. October 17, 1894.
517 Madison avenue, New York, N. Y.
- Woods, George E. October 20, 1897.
Foot East 115th street, New York City, Chief Engineer Stand-
ard Gas Light Co.
- Wortendyke, Ira F. October 27, 1896.
5 North Main street, Janesville, Wis., Superintendent of New
Gas Light Co.
- Yorke, Eugene H. October 19, 1881.
Portland, Me., Engineer of Portland Gas Co.
- Young, James M. H. October 20, 1897.
Pittsburgh, Pa., Superintendent South Side Gas Co.
- Young, John. October 18, 1882.
31 West Diamond street, Allegheny, Pa., Superintendent of
the Allegheny Heating Co.
- Young, Peter. October 21, 1885.
Halifax, N. S., P. O. Box 373, Manager of Peoples Heat and
Light Co.
- Young, Robert. October 20, 1875.
Rebecca street, Allegheny, Pa., Engineer and Superintendent
of Allegheny Gas Co.
- Zeek, Charles F. October 15, 1890.
3 South Palafox street, Pensacola, Fla., Superintendent of Pen-
sacola Gas Co.
- Zollikofer, Oscar F. October 19, 1892.
65 West 54th street, New York, N. Y., Secretary of Consoli-
dated Gas Co.

ASSOCIATE MEMBERS.

- Allen, Walter S. October 19, 1892.
New Bedford, Mass.
- Althouse, Wilson D. October 20, 1897.
Room 719 Reading Terminal, Philadelphia, Pa., Coal Mer-
chant, Althouse & Kennedy.

- Backus, Q. S. October 17, 1894.
Williamsport, Pa., President and General Manager of Backus Manufacturing Co.
- Barrett, S. E. October 18, 1893.
909 Chicago Stock Exchange, Chicago, Ill., President and Treasurer of S. E. Barrett Manufacturing Co.
- Barrows, William E. October 16, 1889.
835 Drexel Building, Philadelphia, Pa., President and General Manager of Welsbach Light Co.
- Behrend, Fritz. October 17, 1894.
10 and 12 Old Slip, New York, N. Y., Clay Gas Retort Importer.
- Birchmore, W. H. October 20, 1897.
231 Adelphi street, Brooklyn, N. Y., Gas Chemist.
- Brown, Frank H. October 19, 1892.
Waltham, Mass., Treasurer and Superintendent of Davis & Farnham Manufacturing Co.
- Buss, Julius. October 19, 1892.
Milwaukee, Wis., P. O. Box 235, Consulting Engineer with Fred. Bredel, Gas Engineer and Contractor.
- Carpenter, H. A. October 20, 1897.
Allegheny, Pa., Engineer with Riter & Conley.
- Coburn, Cyrus M. October 19, 1892.
152 Congress avenue, Chelsea, Mass., Manager of Liberty Oil Co.
- Collins, David J. October 17, 1894.
813 Drexel Building, Philadelphia, Pa., Sales Agent of the United Gas Impt. Co.
- Cooke, Horace G. October 19, 1892.
Address unknown.
- Crane, William M. October 16, 1889.
838 Broadway, New York, N. Y., Wm. M. Crane & Co., Gas Stoves, etc.
- Curley, Edward J. October 18, 1893.
827 Market street, Wilmington, Del., Assistant Superintendent of Wilmington Coal Gas Co.
- Dart, Edward M. October 19, 1892.
136 Clifford street, Providence, R. I., Manager of E. M. Dart Manufacturing Co., Manufacturers of Gas Appliances.

- Dougherty, H. N. October 27, 1896.
Brooklyn, E. D., N. Y., Box 6, Station G, General Salesman
for Farrell Logan & Son.
- Drummond, M. J. October 20, 1897.
192 Broadway, New York, N. Y., Manufacturer of Cast Iron
Pipe.
- Eaton, Alfred B. October 27, 1896.
67 Washington street, Chicago, Ill., Assistant Sales Agent
of The United Gas Improvement Co.
- Goodwin, H. B. October 19, 1892.
1016 Filbert street, Philadelphia, Pa., Superintendent and
General Manager of the Goodwin Meter Co.
- Graves, George W. October 20, 1897.
36 St. Paul street, Rochester, N. Y., Eastern Manager National
Vapor Stove and Manufacturing Co.
- Harris, Andrew. October 15, 1890.
1513 Race street, Philadelphia, Pa., care of J. A. Harris.
- Hartenfels, P. October 20, 1897.
120 Liberty street, New York, N. Y., Manufacturer of Patent
Leak Detector for Street Mains.
- Hastings, James L. October 17, 1894.
138 South 6th street, Philadelphia, Pa., General Superintendent
of National Heat and Power Construction Co.
- Hayward, Sterling F. October 15, 1890.
357 Canal street, New York, N. Y., Treasurer and General
Manager of Connelly Iron Sponge and Gov. Co.
- Henderson, E. H. October 27, 1896.
Pittsburg, Pa., P. O. Box 373, Sales Agent for James Gardner,
Jr.
- Higgins, C. M. October 21, 1891.
26 Broadway, New York, N. Y., with Standard Oil Co.
- Hinman, Charles W. October 27, 1896.
63 Beverly street, Boston, Mass., Manager for Nathaniel Tufts
Meter Co.
- Jacobs, Charles H. October 20, 1897.
Detroit, Mich., Vice-President and Managing Director Buhl
Stamping Co.
- Knight, Charles S. October 15, 1890.
Spy Run avenue, Fort Wayne, Ind., P. O. Box 513, Vice-
President of Fort Wayne Electric Corporation.

- Little, George B. October 19, 1892.
103 State street, Boston, Mass., of Stratton, Little & Co., Coal Dealers.
- Manning, James S. October 21, 1891.
18 Vesey street, New York, N. Y., Agent of Otto Gas Engine Co.
- Mansur, John H. October 17, 1894.
436 Walnut street, Royersford, Pa., P. O. Box 226, President of Keystone Meter Co.
- Mather, Henry A. October 17, 1894.
421 Greenpoint avenue, Brooklyn, N. Y., President and Secretary of Greenpoint Chemical Works.
- Maurer, Henry A. October 19, 1892.
420 East 23d street, New York, N. Y., Of Henry Maurer & Son.
- McDonald, Donald. October 21, 1891.
51 Lancaster street, Albany, N. Y., Superintendent of D. McDonald & Co., Gas Meter Manufacturers.
- Meyer, Hermann H. B. October 18, 1893.
Nevins and Degraw streets, Brooklyn, N. Y., Brooklyn Union Gas Company.
- Mordue, Thomas N. October 16, 1895.
1 Broadway, New York, N. Y., Cannel Coal and Coke Merchant.
- Nicolls, J. O. October 27, 1896.
1326 Chestnut street, Philadelphia, Pa., Treasurer of Shaner Coal Co.
- Norton, Harry A. October 17, 1888.
63 Beverly street, Boston, Mass., P. O. Box 3365, With N. Tufts Meter Co.
- Osius, George. October 16, 1889.
322 Field avenue, Detroit, Mich., Secretary and Treasurer of Michigan Ammonia Works.
- Page, Albion L. October 21, 1891.
69 Wall street, New York, N. Y., Of Geo. Shepard Page's Sons.
- Page, Harry DeB. October 21, 1891.
69 Wall street, New York, N. Y., President U. S. Ammonia Co.

- Pearson, Joshua Ash. October 20, 1897.
833 Drexel Building, Philadelphia, Pa., Assistant Purchasing Agent, The United Gas Impt. Co.
- Persons, Fred R. October 17, 1888.
408 Prescott street, Toledo, Ohio, Representative of Maryland Meter and Mfg. Co.
- Platt, E. S. October 27, 1896.
Room 218 Commercial Building, St. Louis, Mo., Secretary and Treasurer of George Platt & Co.
- Prendergast, Daniel J. October 20, 1897.
33 Nassau street, New York City, General Superintendent Welsbach Street Lighting Company of America.
- Randolph, William W. October 17, 1894.
31 Nassau street, New York, N. Y., Superintendent of Construction, Humphreys & Glasgow.
- Roper, George D. October 27, 1896.
Rockford, Ill., President and Manager of Eclipse Gas Stove Co.
- Scheel, Henry C. October 18, 1893.
11 Broadway, Room 921, New York, N. Y., P. O. Box 2228, Wholesale Coal Dealer.
- Schell, Edward. October 19, 1892.
99th street and 2d avenue, New York, N. Y., Assistant Superintendent of 99th and 111th street Stations, Consolidated Gas Co.
- Slocum, Frank L. October 19, 1892.
Conestoga Building, Pittsburg, Pa., President of the Gas Engineering Co.
- Starr, George W. October 16, 1895.
19 Home place, New Haven, Conn., P. O. Box 1345, Secretary Yale Gas Stove Co.
- Stratton, S. S. October 16, 1889.
107 West Monroe street, Chicago, Ill., Salesman Maryland Meter Co.
- Thomas, Frederick W. October 19, 1892.
102 Milk street, Boston, Mass., Salesman, Waldo Bros.
- Van Wie, E. G. October 27, 1896.
1320 Jefferson avenue, Detroit, Mich., Manager Gas Appliance Department, Detroit Stove Works.

- Van Wie, Peter G. October 18, 1888.
Hamilton, Ohio, Supervisor of Gas Appliances, F. & L. Kahn & Bros.
- Wells, Fred. K. October 27, 1896.
72 Lake street, Chicago, Ill., Treasurer, George M. Clarke & Co.
- Wharton, Henry. October 16, 1895.
224 South 3d street, Philadelphia, Pa., P. O. Box 1322, Asst. Secretary, Westmoreland Coal Co.
- Wilbraham, John S. October 19, 1892.
2518 Frankford avenue, Philadelphia, Pa., Secretary and Treasurer of Wilbraham-Baker Blower Co.
- Wilbraham, John W. October 19, 1892.
2518 Frankford avenue, Philadelphia, Pa., President of Wilbraham-Baker Blower Co.
- Wilke, Frederick A. October 17, 1894.
1114 North E street, Richmond, Ind., Manufacturer of the Wilke China Kiln.
- Wilson, Peter. October 19, 1892.
82 Myrtle avenue, Flushing, N. Y., Assistant Superintendent of Flushing Gas Light Co.
- Woods, Samuel. October 16, 1895.
6720 Thomas street, Pittsburg, Pa., Secretary and Treasurer of Gas Engineering Co.

Honorary Members.....	9
Active Members.....	384
(1 Reinstated Oct. 20, 1897.	
7 Dropped Nov. 5th, 1897, for non-payment of dues.	
1 Resigned since Sept. 30, 1897.	
1 Died since Sept. 20, 1897.)	
Associate Members.....	64
(1 Dropped Nov. 5, 1897, for non-payment of dues.	
1 Resigned since Sept. 30, 1897.)	
Total	457

MEMBERS OF THE AMERICAN GAS LIGHT ASSOCIATION, ARRANGED GEOGRAPHICALLY.

CALIFORNIA.

Anaheim	William J. Fay.	
Pasadena	Thaddeus S. C. Lowe.	
Oakland	John A. Britton.....	13th and Clay streets
San Francisco	Joseph B. Crockett.....	415 Post street
	Frederick H. Eichbaum..	2644 Howard street
	Edward C. Jones.....	415 Post street
	C. O. G. Miller...	Annie and Stevenson streets

COLORADO.

Denver	A. H. Branch.....	405 17th street
--------------	-------------------	-----------------

CONNECTICUT.

Bridgeport	William R. Higby.....	380 Main street
Danbury	Charles H. Merritt.....	350 Main street
Derby	Charles H. Nettleton.....	22 Elizabeth street
Hartford	John P. Harbison.	
	John W. Hatstat.	
	Burdett Loomis.	
Meriden	Charles A. Learned....	47 Washington street
New Britain.....	Everett C. Learned.....	118 Maple street
New Haven.....	F. C. Sherman.....	80 Crown street
	George W. Starr.....	119 Home place
Norwalk.....	L. C. Hanford.....	1 Belden avenue
Stamford.....	Walter M. Jackson.....	9 Oliver street
Waterbury.....	E. H. Williams.....	150 Grand street

DELAWARE.

Wilmington.....	Edward Betts.....	827 Market street
	George S. Capelle.....	827 Market street
	Edward J. Curley.....	827 Market street
	Thomas Curley.....	827 Market street

DISTRICT OF COLUMBIA.

Washington	Charles B. Bailey.....	1424 Staughton street
	Thos. F. Holden....	12th and M streets, S. E.
	John Leetch.....	1409 31st street
	James S. McIlhenny..	26th and G streets, N.W.
	John R. McLean.....	413 10th street, N. W.
	Robert L. Middleton..	1333 30th street, N. W.
Tacoma Park.....	Allen R. Foote.	

FLORIDA.

Jacksonville.....	Clarence S. Hammatt.....	26 Main street
Pensacola.....	Charles F. Zeek.....	3 South Palafox street
St. Augustine.....	B. H. Spangenberg.	
Tampa	A. J. Boardman	Roberts Building

GEORGIA.

Athens	J. T. Bowdoin Cocke.	
Atlanta	W. G. Abel.....	42 West Baker street
	W. L. Cosgrove...	Alabama and Broad streets
	R. M. Searle	Broad and Alabama streets
Augusta	George S. Hookey.....	303 Centre street
Columbus.....	James Ferrier.....	315 12th street
Savannah	James A. P. Crisfield..	7 Congress street, West

ILLINOIS.

Alton	J. F. Porter	205 Market street
Cairo	John W. Eakin.....	709 Levee street
Chicago	S. E. Barrett...	909 Chicago Stock Exchange
	Walter S Dole..	22d street and Center avenue
	A. B. Eaton	67 Washington street
	Charles H. Evans.	4133 Cottage Grove avenue
	Charles E. Judson	148 Michigan avenue
	F. D. Moses.....	111 Lake street
	James R. Smedburg.....	52 Lake street
	S. S. Stratton.....	107 West Monroe street
	Fred. K. Wells.....	72 Lake street
	John Williamson.....	2 East Madison street

Decatur	Walter S. Rathell.....	230 N. Main street
Elgin	Carl H. Dunbar.	
Oak Park.....	Edward E. Morrell.	
Quincy	Augustus W. Littleton.....	111 South 5th street
Rockford	George D. Roper.	
Springfield	William Ridgely.	

INDIANA.

Connersville	D. T. Roots.	
	Anthony Watt..	10th street and Central avenue
Fort Wayne.....	Alfred D. Cressler..	Calhoun & Murray streets
	Olaf N. Guldlin	11 Webster street
	Charles S. Knight.....	Spy Run avenue
Indianapolis.....	James Somerville..	Cor. Penn. & Louisiana sts.
New Albany	James W. Dunbar...	Sycamore and 7th streets
Richmond	James M. Starr.....	10th and North D streets
	Frederick A. Wilke.....	1114 North E street
Terre Haute	M. N. Diall.....	507 Ohio street

IOWA.

Burlington	Edward D. Clary.....	911 North 6th street
Des Moines.....	Edward G. Pratt.....	208 5th street
Sioux City	L. L. Kellogg.....	518 5th street

KANSAS.

Fort Scott	William H. Frost.....	11 East Wall street
------------------	-----------------------	---------------------

KENTUCKY.

Covington	E. H. Jenkins.....	511 Madison avenue
Louisville.....	Clement A. White.....	16 St. James Court
	A. H. Barret.	

LOUISIANA.

New Orleans	Francis Carroll.....	1643 Perdido street
-------------------	----------------------	---------------------

MAINE.

Bangor	Henry Boardman	5 Forest avenue
Portland.....	Eugene H. Yorke.	

MARYLAND.

Baltimore	Edward L. Bartlett..	McHenry & Scott streets
	George Beadenkopf.....	19 South street
	Charles H. Dickey .	North and Saratoga streets
	Francis H. Hambleton.....	19 South street
	Thomas J. Hayward..	McHenry and Scott sts.
	Frederick T. Mayer..	McHenry and Scott sts.
	James B. Smallwood.....	1512 Linden avenue

MASSACHUSETTS.

Boston	Frederick P. Addicks.....	24 West street
	Walter R. Addicks.....	24 West street
	Forrest E. Barker....	State House, Room 145
	Albert C. Burrage.....	24 West street
	Fred J. Davis.....	74 Montgomery street
	W. W. Greenough....	299 Marlborough street
	William H. Hill.....	40 Water street
	Charles W. Hinman.....	63 Beverly street
	John T. Langford.....	70 Kilby street
	George B. Little.....	103 State street
	Harry A. Norton.....	63 Beverly street
	Charles H. Sprague.....	70 Kilby street
	Robert B. Taber.....	8 Oliver street
	Frederick W. Thomas.....	102 Milk street
	Charles S. Waldo.....	102 Milk street
	John A. Waldo.....	102 Milk street
	William A. Wood.....	609 Commercial street
Charlestown	Patrick Coyle.....	27 Arlington avenue
	George B. Neal.....	Thompson square
Chelsea	Cyrus M. Coburn.....	152 Congress avenue
	Henry H. Kelly.....	49 Chestnut street
	George W. Moses.....	187 Winisimmet street
Clinton	Henry N. Bigelow.....	104 High street
	William H. Spaulding.....	98 Walnut street
Dorchester.....	William E. McKay.....	10 Pearl street
East Boston.....	William Anderson.....	32 Condor street
Fall River	Joseph E. Nute.....	14 Bedford street
Fitchburg	H. F. Coggeshall.....	316 Main street
	F. D. Page.....	316 Main street

Gloucester	John A. Coffin	Duncan street
Holyoke	William H. Snow	338 Maple street
Jamaica Plain	Eugene N. Foss	8 Everett street
Lawrence	George D. Cabot.	
	Carl H. Graf.	
	C. J. R. Humphreys	256 Essex street
Lynn	Charles C. Fry	90 Exchange street
	Charles F. Prichard	8 Central square
New Bedford	Walter S. Allen.	
	Nathaniel W. Gifford.	
Newton	Waldo A. Learned	2 Jewett street
North Adams	Frank S. Richardson	9 Elmwood avenue
Northampton	David W. Crafts	116 Main street
Salem	David Moore	110 Federal street
Springfield	Samuel J. Fowler.	
Taunton	Henry B. Leach	21 Franklin street
Wakefield	Charles S. Spaulding	Railroad street
Waltham	Frank H. Brown.	
	Charles F. Spaulding	Warren avenue
Worcester	Charles D. Lamson	33 Pearl street

MICHIGAN.

Adrian	Charles H. Raynor	111 North Winter street
Ann Arbor	Henry Douglas	107 South 5th avenue
Detroit	Isaac C. Baxter	636 Trumbull street
	Jerome Croul	Lewis block, room 4
	Charles H. Jacobs.	
	Eugene T. Lynch.	
	James T. Lynn	Russell House
	George Osius	322 Field avenue
	E. G. Van Wie	1320 Jefferson avenue
Grand Rapids	H. D. Walbridge	111 Ottawa street
Pontiac	William H. Morgans	36 Wessen street

MISSOURI.

Kansas City	George S. Clarke	9th and Central streets
	Milton J. Payne	10th and Walnut streets

St. Joseph	Kerr M. Mitchell.....	516 Francis street
St. Louis.....	Byron E. Chollar.....	411 North 11th street
	John Dell.....	901 Pine street
	James Green.....	901 Pine street
	Thomas G. Lansden..	Room H, 108 N. 4th st.
	E. S. Platt.....	218 Commercial Building
	Alexander Ross.....	411 North 11th street
	Daniel R. Russell.....	417 Pine street
	Orrell O. Thwing ..	Main and Howard streets

NEBRASKA.

Omaha	Isaac Battin.....	217 South 13th street
-------------	-------------------	-----------------------

NEW HAMPSHIRE.

Manchester	Walter G. Africa.....	46 Hanover street
------------------	-----------------------	-------------------

NEW JERSEY.

Bayonne City	William H. Smith	201 Avenue D
Camden	Benjamin F. Archer.....	319 Cooper street
	Charles Watson.....	432 Federal street
Hackensack.....	Frank B. Poor.	
	George F. Summers.	
Hoboken	Henry Morton.....	Stevens Institute
	F. N. Morton..	Willow avenue and 13th street
Montclair.....	A. E. Forstall.	
Jersey City.....	West Bissell.	
	David R. Daly.....	Green and Essex streets
	Dudley D. Flemming..	249 Washington street
	John M. Rusby.....	109 Montgomery street
Lambertville	A. C. Gandy.....	31 Bridge street
Long Branch.....	Paul Doty	168 Broadway
	Fred B. Wheeler.....	168 Broadway
Newark	Rezeau B. Brown.....	Market street
	Samuel Philip Curtis.....	26 Front street
	Thomas B. Fogarty.....	49 9th avenue
	Alexander H. Strecker.	
	Eugene Vanderpool.....	757 Broad street

Paterson.....	W. H. Rogers.....	146	Elison street
	W. L. Williams.....	183	Tyler street
Princeton.....	James E. Burke.		
Trenton.....	John S. Chambers.....	193	Brunswick avenue
	Levi Stevens, Jr.....	39	Philimon street

NEW YORK.

Albany.....	Donald McDonald.....	51	Lancaster street
	William McDonald.....	51	Lancaster street
	Frank N. Sission.....	139	Lancaster street
Bath.....	William H. Scrafford.		
Brooklyn.....	Fred S. Benson..		Kent avenue and Cross street
	W. H. Birchmore.....	231	Adelphi street
	Charles W. Blodget.....	324	Bedford avenue
	Robert W. Bush..		12th st. and Gowanus Canal
	Thomas E. Byrne.....	51	Montgomery place
	Charles H. Corbett....	428	Lafayette avenue
	H. N. Dougherty.		
	James H. Jourdan .		Nevins and Degraw streets
	John D. Logan.		
	William J. Logan.		
	Edwin Ludlam.....	180	Remsen street
	Henry A. Mather.		
	Herman H. B. Meyer .		Nevins and Degraw sts.
	Charles L. Rowland.....	61	Morton street
	T. F. Rowland, Jr.....	170	Keap street
	Henry C. Slaney.....	466	6th street
	Ira N. Stanley.....	310	Washington avenue
	William A. Stedman....	785	Flatbush avenue
	Edward D. White.....	265	Stuyvesant avenue
Buffalo.....	John H. Cowing.....	11	E. Seneca street
	J. T. Herron.....	293	Court street
	Joseph Krumholz....	249	West Genesee street
Corning.....	Frank D. Kingsbury....	8	East Market street
Far Rockaway, L.I.	Elmer B. Knight.		
Flushing.....	Peter Wilson.....	82	Myrtle avenue
Hornellsville.....	T. W. Summers.		
Ilion, Herkimer Co.	John A. Giblin.....	8	East Main street
	Thomas Ringwood.....	4	Armory street

Kingston	Franklin Tobey, Jr.....	112 Jansen avenue
Lockport	Walton Forstall..	Transit and Lagrange street
Long Island City ..	Alten S. Miller.	
Middletown, N. Y. .	William J. Max.....	13 William street
Mt. Vernon.	Charles L. Gerould .	N. Third & Prospect aves.
	James W. Lane.	
Newburg	Benjamin J. McDonald.....	70 Water street
New York	William A. Armington.....	10 Wall street
	Thaddeus R. Beal...	138th st. and East River
	William R. Beal.....	350 Alexander avenue
	Fritz Behrend.....	10 and 12 Old Slip
	Fred L. Bradley....	99th street and 2d avenue
	William H. Bradley.....	4 Irving place
	Ernest C. Brown.....	280 Broadway
	John S. Bush.....	1845 Vanderbilt avenue
	John Cabot.....	553 West 33d street
	E. P. Callender.....	32 Pine street
	William Carpenter.....	32 Pine street
	C. F. Chandler.....	41 East 49th street
	William M. Crane.....	838 Broadway
	J. Alfred Dixon.....	160 Broadway
	Robert M. Dixon.....	160 Broadway
	M. J. Drummond.....	192 Broadway
	George B. Edwards.....	113 Chambers street
	Robert F. Fitz.....	253 Broadway
	Frederick W. Floyd.....	539 West 20th street
	Henry E. Floyd.....	539 West 20th street
	James R. Floyd.....	539 West 20th street
	P. Hartenfels.....	120 Liberty street
	Sterling F. Hayward.....	357 Canal street
	Richard S. Hicks.....	73 Warren street
	C. M. Higgins.....	26 Broadway
	David L. Hough.....	117 West 58th street
	Alexander C. Humphreys...	31 Nassau street
	Charles W. Isbell.....	245 Broadway
	George F. Kreischer.....	119 East 23d street
	E. G. Love.....	122 Bowery
	Ferdinand McKeige.....	31 Broadway
	J. S. Manning.....	18 Vesey street
	Henry A. Maurer.....	420 East 23d street

New York	Emerson McMillin.....	40	Wall street
	William N. Milsted.....	512	West 22d street
	Thomas N. Mordue.....	1	Broadway
	Albion L. Page.....	69	Wall street
	Harry DeB. Page.....	69	Wall street
	James D. Perkins.....	228	Produce Exchange
	Henry M. Pierson.....	114	Broad street
	Daniel J. Prendergast.....	33	Nassau street
	William W. Randolph.....	31	Nassau street
	A. F. Reichelt.....	350	Alexander avenue
	Thomas F. Rowland.....	329	Madison avenue
	Henry C. Scheel.....	11	Broadway, room 921
	Edward Schell.....	99th street and 2d avenue	
	F. Seaverns.....	228	Produce Exchange
	Robert A. C. Smith.....	100	Broadway
	G. Treadway Thompson.....	40	Wall street
	Adam Weber.....	633	East 15th street
	Oscar B. Weber.....	633	East 15th street
	A. F. Wehner.....	245	Broadway
	William Henry White.....	32	Pine street
	Charles R. Whittier.....	306	11th avenue
	Charles D. Woodruff.....	517	Madison avenue
	George E. Woods.....	Foot East 115th street	
	Oscar F. Zollikoffer.....	65	West 54th street
Nyack	A. M. Voorhis.....		Broadway
Ogdensburg.....	J. H. Findlay.....	17	Franklin street
	William L. Proctor.....	62	Washington street
Port Chester	Clefford L. Slade.		
Port Jervis.....	John Collins.....	1	Mt. William
Poughkeepsie	Augustus L. Allen.....	384	Mill street
	John Tracy	35	Market street
Rochester	G. W. Graves.....	36	St. Paul street
Sing Sing.....	Leonard P. Kipp.		
Syracuse.....	T. Littlehales.....	1	Durston Memorial building
	Austin C. Wood.....	216	North West street
Utica	Edward A. Pinkney.....	29	Whitesboro street
Watertown.....	Henry C. Whitney.....	19	Anthony street
White Plains.....	Richmond E. Slade.		
Yonkers	James Slade.....	95	Woodworth avenue

NORTH CAROLINA.

Asheville	Henry Mactier.
Brevard	Arthur E. Boardman.
Raleigh	Bowes, M.
Wilmington	John W. Reilly.....116 South 6th street

OHIO.

Akron.....	F. W. Little.....223 East Market street
Bucyrus	J. W. Gwynn.
Cincinnati	Andrew Hickenlooper.....838 Dayton street
	William A. Miller.....2817 Eastern avenue
	William Stacey.....39 Mill street
	James E. Stacey.....39 Mill street
Cleveland	Malcolm S. Greenough.....356 Superior street
	Gustavus A. Hyde.....85 Kennard street
	Virgil G. Marani.....356 Superior street
	Daniel R. Warmington.....412 Pearl street
	George H. Warmington.....412 Pearl street
Columbus	Irvin Butterworth.....135 North Front street
Dayton.....	W. P. Callahan.....901 East Third street
	Robert R. Dickey.....Main and 2d streets
	Henry C. Graves.....Main and 2d streets
	Joseph Light.....203 East First street
Hamilton.....	Peter G. Van Wie.
Toledo	C. A. Byers.
	Charles R. Faben, Jr....327 South Erie street
	Fred R. Persons.....408 Prescott street
Warren.....	George H. Tayler.....209 Main street
Zanesville.....	Eugene Printz.....188 North 5th street

OREGON.

Portland.....	Charles F. Adams.....235 Stark street
---------------	---------------------------------------

PENNSYLVANIA.

Allegheny	H. A. Carpenter.
	John Young.....31 West Diamond street
	Robert Young.....Rebecca street
Allentown	Arthur F. Bigelow.....540 Hamilton street

Altoona	George H. Harper.....	2526 Broad avenue
	John Lloyd.....	First National Bank
Ardmore	W. E. Barrett.....	Stark avenue
Coatesville.....	P. H. Gibbons.....	407 Chestnut street
Easton	William H. Ward.....	228 Front street
Honesdale	Henry Z. Russell.....	Main and 8th streets
Johnstown	Anderson H. Walters.....	420 Main street
Lancaster	John H. Baumgardner.....	129 North Queen street
Philadelphia	Harry C. Adams.....	224 South Third street
	J. Edward Addicks.....	1500 Market street
	W. D. Althouse . Room 719,	Reading Terminal
	William E. Barrows.....	835 Drexel building
	A. B. Beadle.....	813 Drexel building
	Samuel T. Bodine.....	813 Drexel building
	Cyrus Borgner.....	23d street, above Race
	James Buckman.....	8th and Green streets
	William Cartwright.....	3413 Baring street
	Walton Clark.....	813 Drexel building
	D. J. Collins.....	813 Drexel building
	F. A. Dingee.....	720 Reading Terminal
	Arthur B. Eilbeck.....	Drexel building
	George W. Elkins.....	423 Walnut street
	William L. Elkins, Jr.....	606 Bourse building
	William P. Fodell.....	50 Laurel street
	John Fowler.....	39 Laurel street
	William H. Gartley.....	3044 Richmond street
	W. W. Gibbs.....	813 Drexel building
	H. B. Goodwin.....	1016 Filbert street
	W. W. Goodwin.....	532 Bourse building
	George W. Graeff, Jr.	
	John Gribbel.....	1513 Race street
	Andrew Harris.....	1513 Race street
	J. A. Harris.....	1513 Race street
	James L. Hastings.....	138 South 6th street
	Charles D. Hauk.....	138 South 6th street
	William E. Helme.....	1339 Cherry street
	William H. Hopper,	
	131 West Walnut lane,	Germantown
	Edward C. Lee.....	813 Drexel building
	Lewis Lillie.....	813 Drexel building

Philadelphia	William MacDonald...	36th Ward Gas Works
	Alex. J. McCleary....	23d and Market streets
	Edmund H. McCullough .	224 South 3d street
	John McIlhenny	1339 Cherry street
	John D. McIlhenny.....	1339 Cherry street
	Henry G. Morris.....	926 Drexel building
	J. O. Nicolls.....	1326 Chestnut street
	Rollin Norris.....	813 Drexel building
	Carter H. Page, Jr.....	813 Drexel building
	William K. Park...	Juniper and Filbert streets
	Joshua Ash Pearson.....	833 Drexel building
	George G. Ramsdell	222 South 3d street
	George J. Roberts.....	813 Drexel building
	William L. Rowland....	4800 Chester avenue
	William J. Serrill.....	813 Drexel building
	F. H. Shelton.....	524 Drexel building
	John W. Smith.....	60 Laurel street
	Henry Steck....	631 Chestnut street, room 12
	J. W. Stirzel.....	3448 Frankford avenue
	Morris W. Stroud.....	222 South Third street
	Henry Wharton.....	224 South Third street
	John S. Wilbraham....	2518 Frankford avenue
	John W. Wilbraham....	2518 Frankford avenue
	Walter Wood.....	400 Chestnut street
Pittsburg	James Gardner, Jr., Room 34,	Conestoga bldg.
	William Gardner..	Room 34, Conestoga bldg.
	E. H. Henderson.	
	D. Herbert Hostetter.....	59 Water street
	John L. McElroy.....	435 Sixth avenue
	F. Schniewind.....	311 Lewis block
	Frank L. Slocum.....	Conestoga building
	John F. Wilcox.....	311 Lewis block
	Samuel Woods.....	6720 Thomas street
	J. M. H. Young.	
Reading	John H. Keppelman....	144 North 4th street
Royersford.....	John H. Mansur.....	436 Walnut street
	Joshua J. Nix.....	353 Church street
Wilkes-Barre	Marcus Smith....	Welles bldg., Public square
Williamsport	Q. S. Backus.	
York	Jacob L. Kuehn..	33 East Philadelphia street

RHODE ISLAND.

Bristol	W. Russell Bogert.	
Newport	A. K. Quinn.....	181 Thames street
Providence	Edward M. Dart.....	136 Clifford street
	A. B. Slater.....	Rear 20 Market square
	A. B. Slater, Jr.....	101 Public street
Riverside.....	James H. Armington.	
Woonsocket	Zeuner M. Jenks.	

SOUTH CAROLINA.

Charleston.....	Thomas Turner.....	224 Calhoun street
Columbia.....	John M. Daniels.....	1344 Main street

TENNESSEE.

Chattanooga	James Forbes.....	619 Cherry street
Memphis	J. H. Cardall.....	Main and Mill streets

TEXAS.

Galveston	John Gimper.....	32d and Market streets
-----------------	------------------	------------------------

VIRGINIA.

Norfolk	Harry L. Rice.	
	Frederick Egner.....	26 Hamilton avenue
Newport News	William S. Bowen.	
Petersburg	William H. Baxter.....	201 Sycamore street
Portsmouth.....	Henry H. White.	
Richmond	W. P. Knowles.	
Roanoke	Edwin G. Holzer.....	204 Terry building
	John C. Rawn,	
	Terry building, Jefferson & Campbell sts.	

WASHINGTON.

Seattle	C. Russell Collins.	
---------------	---------------------	--

WISCONSIN.

Appleton	George McMillan.....	565 Oneida street
Eau Claire.....	David Douglas.	

Janesville.....	Ira F. Wortendyke.....	5 North Main street
Madison.....	Henry Doherty.	
Milwaukee.....	Frederick Bredel.....	118 Farwell avenue
	Julius Buss.	
	Edw. G. Cowdery,	Milwaukee & Michigan sts.
	Sheldon J. Glass	Montgomery building
	Howard C. Slater,	Menominee & Jefferson sts.
	James H. Walker.....	249 27th street

ENGLAND.

Liverpool.....	William King.....	Duke street
London	Arthur G. Glasgow...S. W.,	9 Victoria street
	George T. Livesey.....	Old Kent Road
	J. A. Norcross.....	9 Victoria street
	John T. Westcott,	
	19 Abingdon street,	Westminster, S. W.
	Corbet Woodall.	Palace Chamber, Westminster

NEW BRUNSWICK.

St. John	J. A. Faux.
----------------	-------------

NOVA SCOTIA.

Halifax	Robert Baxter.
	Peter Young.

ONTARIO, CANADA.

Hamilton.....	Fred. W. Gates.....	17 Herkimer street
	Edmund Cathels.	
Ottawa.....	John R. Coates.....	23 Spark street
Toronto	William H. Pearson.....	19 Toronto street
	William H. Pearson, Jr.....	95 Isabella street
Windsor.....	Abner F. Nash.	

QUEBEC, CANADA.

Quebec	David H. Geggie.....	2 Place d'Orleans
--------------	----------------------	-------------------

ADDRESS UNKNOWN.

Horace G. Cooke.

W. P. Elliott.

New England.....	72
Middle States.....	231
District of Columbia and South, east of the Mississippi River.	38
North of Ohio River, and east of the Mississippi River.....	61
West of Mississippi River.....	37
Canada and Nova Scotia.....	10
England.....	6
Address unknown.....	2
Total	457

MEMBERS DECEASED.

George W. Parsons.....	Rochester, N. Y.....	—	—, 1875
Cornelius L. Everett.....	New York, N. Y.....	Oct.	—, 1875
G. T. Sutton.....	Peekskill, N. Y.....	Apr.	—, 1876
Charles Collier.....	Selma, Ala.....	May	—, 1876
W. H. Perry.....	Bangor, Me.....	May	—, 1877
William B. Clelland.....	Vicksburg, Miss.....	Oct.	15, 1878
Gen. Laz Noble.....	Vincennes, Ind.....	Oct.	18, 1879
George Buist.....	Halifax, N. S.....	Nov.	2, 1879
Oliver G. Steele	Buffalo, N. Y.....	Dec.	10, 1879
George W. Edge	Jersey City, N. J.....	Jan.	1, 1880
Kerr Murray.....	Ft. Wayne, Ind.....	May	6, 1880
John C. Buxton.....	Springfield, O.....	July	20, 1880
George Dwight.....	Springfield, Mass.....	Feb.	1, 1881
Elmer W. Clark, Jr.	Philadelphia, Pa.....	Mar.	5, 1881
Eli Butler.....	Meriden, Conn.....	May	24, 1881
Henry Budd.....	Philadelphia, Pa.....	May	28, 1881
Henry Cartwright.....	Philadelphia, Pa.....	June	30, 1881
Edwin Keith.....	Taunton, Mass.....	Apr.	30, 1882
Geo. Warren Dresser (<i>Honorary</i>),	New York, N. Y.....	May	27, 1883
M. H. Jones.....	Easton, Pa.....	June	1, 1883
W. H. PRICE.....	Cleveland, O.....	June	8, 1883
James D. Merriman	Vera Cruz, Mexico.....	June	10, 1883
A. W. Richardson.....	North Adams, Mass.....	Sept.	4, 1883
Miles W. Caughey.....	Erie, Pa.....	Sept.	20, 1883
Wilmer G. Cartwright.....	Hoboken, N. J.....	Feb.	23, 1884
Philips Peebles.....	Quebec, Can.....	May	15, 1884
Ignaz Herzog	New York, N. Y.....	Oct.	23, 1884
Thomas Butterworth.....	Rockford, Ill.....	Apr.	5, 1885
George Cornell.	Youngstown, O.....	Apr.	22, 1885
Francis Thompson.....	Charlestown, Mass.....	Aug.	30, 1885
James D. Brewer.....	Springfield, Mass.....	Feb.	7, 1886
Emile J. Durand (<i>Honorary</i>)	Paris, France.....	Feb.	—, 1886
John Anderson	Ironton, O.....	June	25, 1886
James H. Walker, Sr.....	Tonawanda, N. Y.....	Mar.	1, 1887
T. F. White.....	Houston, Texas	Feb.	28, 1888
John C. Pratt.....	Jamaica Plain, Mass.....	June	7, 1888
William Helme.....	Atlanta, Ga.....	June	12, 1888
Joseph H. Collins	Philadelphia, Pa.....	June	26, 1888
John M. Murphy.....	Baltimore, Md.....	Aug.	25, 1888
John McDougall.....	Hornellsville, N. Y.....	Nov.	2, 1888
C. H. Nash.....	St. Louis, Mo.....	Nov.	9, 1888
John Cartwright.....	Poughkeepsie, N. Y.....	Dec.	19, 1888
C. F. Maurice.....	Sing Sing, N. Y.....	Dec.	24, 1888
Robert B. Spice (<i>Honorary</i>)	London, England.....	May	11, 1889
Edward J. King.....	Jacksonville, Ill.....	Oct.	28, 1889

ccxviii

Oliver E. Cushing	Lowell, Mass.....	Jan.	17,	1890
THEOBALD FORSTALL.....	Chicago, Ill.....	Jan.	19,	1890
Willam Parrish.....	Seneca Falls, N. Y.....	Jan.	19,	1890
Walter B. Houston.....	Rahway, N. J.....	Apr.	3,	1890
James Henri Rollins.....	Worcester, Mass.....	June	19,	1890
GEN. CHARLES ROOME (<i>Honorary</i>)	New York, N. Y.....	June	28,	1890
B. F. Sherman.....	New York, N. Y.....	Oct.	31,	1890
Nathaniel Tuffts.....	Boston, Mass.....	Nov.	9,	1890
Geo. W. Kraft.....	Philadelphia, Pa.....	Dec.	22,	1890
William Mooney.....	New York, N. Y.....	Jan.	21,	1891
William H. Down	New York, N. Y.....	Feb.	15,	1891
I. Linton.....	Ravenna, O.....	Mar.	—,	1891
J. M. Sterling.....	Monroe, Mich.....	May	18,	1891
E. M. Russell.....	St. Louis, Mo.....	May	28,	1891
Samuel Prichitt.....	Nashville, Tenn.....	Sept.	21,	1891
John Andrew	Chelsea, Mass.....	Feb.	10,	1892
Geo. Shepard Page.....	New York, N. Y.....	Mar.	26,	1892
Charles Nettleton.....	New York, N. Y.....	May	5,	1892
Alfred M. Norton.....	Nashua, N. H.....	July	13,	1892
George A. McIlhenny.....	Washington, D. C.....	Oct.	16,	1892
John J. Griffin.....	Philadelphia, Pa. .	Oct.	22,	1892
Austin M. Copp.....	Boston, Mass.....	Nov.	1,	1892
Fred. H. Odiorne.....	Boston, Mass.....	Jan.	3,	1893
Frank H. Dyer.....	Salt Lake City, Utah.....	Mar.	—,	1893
Matthew Cartwright.....	Rochester, N. Y.....	Apr.	25,	1893
Henry C. Hordley.....	Cumberland, Md.....	May	5,	1893
Edward Jones.....	South Boston, Mass.....	Aug.	1,	1893
Thomas C. Hopper.....	Philadelphia, Pa.....	Feb.	23,	1894
Frederick A. Sabbaton.....	Troy, N. Y.....	Apr.	14,	1894
John H. Knowles.....	Richmond, Va.....	May	5,	1894
Paul S. Merrifield.....	New York, N. Y.....	May	12,	1894
Samuel G. Stiness.....	Pawtucket, R. I.....	Nov.	5,	1894
Thomas D. Gilbert.....	Grand Rapids, Mich.....	Nov.	18,	1894
Geo. Henry Wells.....	Nashville, Tenn.....	Nov.	22,	1894
Thomas C. Cornell.....	Yonkers, N. Y.....	Dec.	29,	1894
Sylvester S. Townsend.....	New York, N. Y.....	Jan.	14,	1895
Jas. McCutcheon.....	Pittsburg, Pa.....	Mar.	4,	1895
Oscar Zollikoffer.....	New York, N. Y.....	Apr.	7,	1895
A. P. Collins.....	New Britain, Conn.....	Apr.	21,	1895
Wm. C. Adams.....	Richmond, Va.....	May	19,	1895
C. A. Bennett, Jr.....	Freehold, N. J.....	July	24,	1895
Wilbur H. Townsend.....	New York, N. Y.....	Feb.	26,	1896
Jos. R. Thomas.....	New York, N. Y.....	Nov.	28,	1896
Jos. D. Weeks	Pittsburg, Pa.....	Dec.	26,	1896
John W. Newell.....	New Brunswick, N. J.....	Jan.	5,	1897
Fred W. Norton.....	Nashua, N. H.....	Oct.	2,	1897

Number deceased while on Roll.....91.

UNIVERSITY OF ILLINOIS-URBANA



3 0112 079784192